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BRUCE GS "B" COMMISSIONING
AQUATIC BIOLOGICAL STUDY, YEAR II, 1984

Report No 90-212-K

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ABSTRACT

This report presents the results of the second of four years (1983-1986) of aquatic studies during the period of commissioning of Bruce GS "B". Although features of the physical environment were generally similar to those seen in previous years, current and temperature data together suggested that 1984 was an unusually severe year in terms of natural physical disturbance of nearshore habitat. Offshore deflection of (to the) northeast currents was produced by the Bruce GS "B" groins and discharge jet with one unit in operation, but changing current patterns did not result in accumulations of sand or silt to either side of the discharge. Fish catches were generally similar in composition to those obtained in previous years, although catches of alewife and round whitefish decreased while catches of gizzard shad, rainbow smelt and burbot increased. Walleye were concentrated on the northern transects, where nets were exposed to temperatures up to 4°C above ambient. Both walleye and round whitefish were sampled at the site as adults only and peaked in abundance in late fall. Some round whitefish spawning apparently occurred in or near the study area in late November-early December. Acoustic surveys provided no evidence that fish were attracted to the intake or avoided it.

job	file	date	report no.
34-126-401	837.321 BRU	September 26, 1990	90-212-K

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EXECUTIVE SUMMARY

BRUCE GS "B" COMMISSIONING AQUATIC BIOLOGICAL STUDY, YEAR II, 1984

H. Balesic

Bruce GS "B" is a 3400 MW nuclear generating station on the northeastern shore of Lake Huron, and is part of the Bruce Nuclear Power Development (BNPD). This report presents the results of the second of four years (1983-1986) of aquatic studies during the period of commissioning of Bruce GS "B". The objectives of these studies were i) to provide continuity of data between preoperational and postoperational studies and ii) to identify any significant environmental alterations resulting from construction and operation of the station during the commissioning period.

The first Bruce GS "B" unit to become critical was Unit 6, on May 29, 1984, and this was followed by Unit 5 on November 15, 1984. During this study the maximum level of operation was 100% capacity for Unit 6 and 60% capacity for Unit 5, and the maximum intake volume was 75 m^3/s (early November). The principal construction activity affecting the aquatic environment was the extension of the discharge groins (dykes) by 60 m during the months of June and July.

Descriptions of the physical environment were based on data collected and reported by Geotechnical and Hydraulic Engineering Department, Design and Development (water temperatures and currents) and by Biological Research. Seasonal changes in nearshore water temperature structure were generally similar to those seen in previous years. The summer regime was dominated by wind-driven mass water movements such as upwellings which were similar in magnitude, but more frequent than those seen in 1983. Mean current speed, dominance of (to the) northeast currents and current persistence were all greater in 1984 than 1983 or the long-term average. The current and temperature data together suggest that 1984 was an unusually severe year in terms of natural physical disturbance of the nearshore aquatic habitat.

The influence of the Bruce GS "B" thermal discharge on the nearshore temperature structure was first seen in a July 18 temperature profile series.

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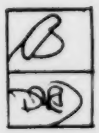
Subsequently, drogue studies in August indicated that offshore deflection of northeast currents was produced by the Bruce GS "B" groins and discharge jet with only one unit in operation. There was concern that, as a result of altered current patterns, fine substrates (sand and silt) could accumulate and potentially interfere with fish spawning. However, detailed surveys of substrates in the vicinity of the discharge showed that fine substrates were a minor component both before and after extension of the discharge groins.

Biological studies were primarily directed at continuing the data base for fish community composition and distribution. The monthly index gill netting program over the standard May - November period produced catches generally similar in composition to those obtained in previous years. A relatively low total catch reflected a decrease in the catch of alewife. At the same time, there were increases over previous years in the relative contribution and cath-per-unit effort of gizzard shad, rainbow smelt and burbot. Round whitefish decreased in the catch by approximately 50% from 1983, and were replaced by white sucker as the most common species in the relatively sparse early winter (December) catch.

Seasonal variation in catch-per-unit effort and inshore-offshore spatial distribution of major fish species were generally consistent with previous years' observations, although temporary reversals in normal summer inshore-offshore movements of some fish species were apparently caused by a major upwelling of cold water in August. There were no obvious or consistent trends in the alongshore spatial distributions of fish, with the exception of walleye which were concentrated on the northern transects. Nets at these transects were exposed to maximum temperatures up to 4°C above inshore ambient in fall, 1984, and BNPD discharges north of the Bruce GS "B" site probably contributed most of the observed temperature elevation.

Length, weight and scale samples (for possible age determination) were taken from all trout, salmon and whitefish and any other game fish caught in the netting survey. The most common of these were round whitefish, an abundant endemic salmonid species of potential commercial value, and walleye, a highly valued sport fish. Both species were sampled at the site as adults only, although juvenile round whitefish were common in Ministry of Natural Resources netting in deeper water 50 km north of BNPD. Some round whitefish spawning apparently occurred in or near the study area between the November and December sampling periods, which was consistent with previous years' results. Walleye were not caught at the site during their spring reproductive period.

June and September acoustic surveys on a grid of transects centered on the intake did not show consistent spatial trends in the distribution of fish relative to the intake. There was no evidence to suggest either attraction to or avoidance of the intake structure or depression by alewife and yellow perch, which apparently contributed most of the fish echoes.



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BRUCE GS "B" COMMISSIONING
AQUATIC BIOLOGICAL STUDY, YEAR II, 1984

1.0 INTRODUCTION

Bruce GS "B" is a 3400 MW nuclear generating station on the northeastern shore of Lake Huron, and is part of the Bruce Nuclear Power Development (BNPD). This report presents the results of the second of four years (1983-1986) of aquatic studies during the period of commissioning of Bruce GS "B". The objectives of these studies were i) to provide continuity of data between preoperational and postoperational studies and ii) to identify any significant environmental alterations resulting from construction and operation of the station during the commissioning period. Year I Aquatic Commissioning Studies (1983) were reported in OHRD Report No 86-166-K. Preoperational studies (1979-1982) were summarized in OHRD Report No 87-185-K.

The first Bruce GS "B" unit to become critical was Unit 6 on May 29, 1984. Unit 6 reached full electric power output on July 20 and was declared in service in September. With the exception of a 10 day shutdown during July and August, the unit operated at 100% capacity until December, 1984. Unit 5 became critical on November 15, 1984, reached approximately 60% of capacity by the end of 1984 and was declared in service in March of 1985. During this study the volume of water drawn through the submerged intake (condenser cooling water + service water) reached a maximum of 75 m^3/s (early November).

The principal construction activity affecting the aquatic environment was the extension of the discharge groins (dykes) by 60 m during the months of June and July.

2.0 METHODS

The study area (Figure 2-1) extended from Douglas Point in the north to Gunn Point in the south, with sampling points and transects similar to those utilized in the Year I Commissioning Studies (OHRD Report No 86-166-K). Field sampling extended from May to December (Table 2-1).

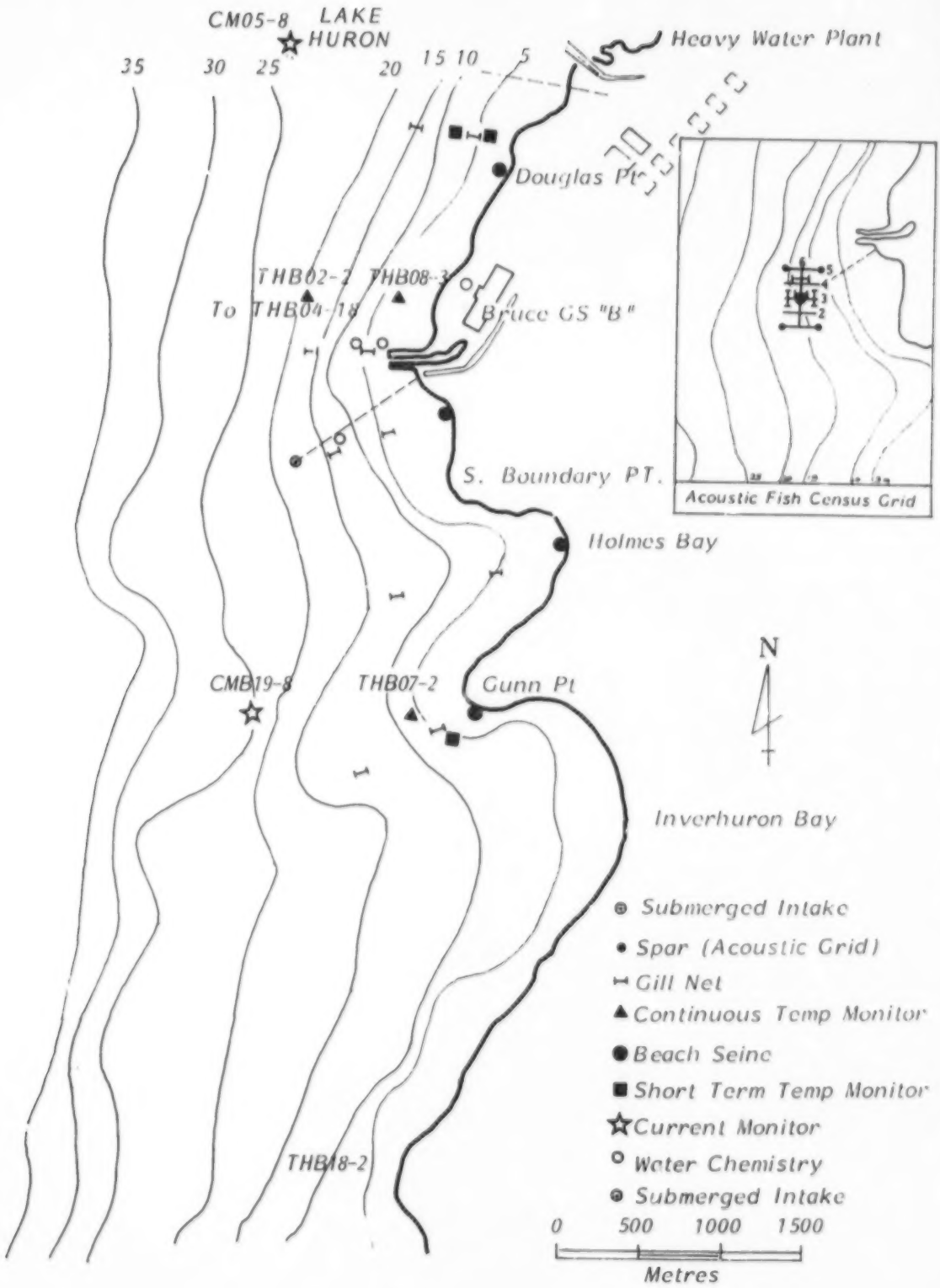


FIGURE 2-1
AQUATIC SAMPLING LOCATIONS AT BRUCE G.S. "B", 1984

TABLE 2-1

SAMPLING SCHEDULE, BRUCE GS "B" 1984

Parameter	Month							
	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
G&HE Temperature and Current Meters	(- - - - - - - continuous April to early December - - -)							
Transparency & Aerial Survey	X				X			
Substrate and Algal Mapping		X		X				
Lake Gill Netting and Fish Biology	X	X	X	X	X	X	X	X
Discharge Netting	X							
Acoustic Fish Census (Intake)		X			X			

2.1 Physical Characteristics

Water temperature was monitored continuously from April 24 to December 10, 1984 at four locations (Figure 2-1) as part of the Geotechnical and Hydraulic Engineering Dept (G&HE) program. During the same period G&HE monitored lake currents at two locations. Additionally, G&HE carried out drogue tracking studies in the vicinity of Bruce GS "B" on May 2 and 3, and August 28 and 30, before and after start-up of the first generating unit and extension of the discharge groins. Details of positioning and methodology in work carried out by G&HE are given in their Reports Nos 86180 (temperatures), 85301 (currents) and Technical Memorandum of April 23, 1985 (drogue tracking).

To allow assessment of the effect of the extended groins and 1- unit discharge on turbidity patterns, aerial surveys were conducted on May 24 and September 6. On May 24 this was accompanied by Secchi depth determinations in the northern portion of the site, but further attempts to obtain Secchi depths which could be correlated to turbidity observed from the air were thwarted by rough conditions. To allow assessment of the effect of discharge groin extension on the deposition of fine substrates, SCUBA surveys were conducted on June 5-7 and August 28-29.

Divers followed lines lain on bottom along the 1, 3, 5 and 7 m contours for 1 km to either side of the discharge channel. Line position was determined by echo sounder; the inshore-offshore positional error, relative to the mapped position (Figure 3-5), was estimated to be a maximum +/- 30 m in the area where depth contours were furthest apart (thus less sharply defined). Divers made an integrated estimate of per cent cover to 1 m on either side of the line over 50 m intervals (marked on the lines) using the standard substrate particle size categories of preoperational studies (OHRD Report No. 83-507-K).

The presence and thickness of silt covering was noted, but not included in the per cent composition estimates, as it did not obscure underlying coarser substrates. The extent of cover by attached algae and the characteristics of the algae were also recorded.

2.2 Fish Distribution and Biology

Adult and juvenile fish were collected from nearshore waters in a gill netting program identical to that in Year I Commissioning Studies. Experimental nets were made of braided nylon and consisted of nine panels 15.3 m (50 ft) long and 1.8 m (6 ft) high, with mesh sizes from 2.5 cm (1 in) to 12.7 cm (5 in) in 1.3 cm (1/2 in) increments arranged serially (not randomly). Nets were set on bottom perpendicular to shore from the 3 and 12 m contours, with the small mesh usually fished at the inshore end. Five transects were fished, from Douglas Point in the north to Gunn Point in the south (Figure 2-1).

Two consecutive 24-hr sets were scheduled monthly from May to December. However, severe weather or other factors resulted in delayed retrieval or cancellation of some sets, while the second August set was cancelled at the request of the Ministry of Natural Resources to accommodate a local angling derby. Data from September were lost with the exception of that recorded on scale envelopes for salmonid and other game species.

For the purposes of Catch-Per-Unit Effort (CUE) calculation, 24-hr, 48-hr and 72-hr sets were considered as 1, 2 and 3 units of effort. Extended-set data were treated in this way because comparisons of single and multiple-day catches at Bruce GS "B" indicated that it would provide a more realistic estimate of relative abundance. This approach may be more suitable for BNPD than other sites because fouling of nets by algae is not a problem. In CUE comparisons 2.5 cm mesh and 3.8 to 12.7 cm mesh panels were treated as two separate gear types to facilitate among year and among site comparisons. Complete data on effort by date and location are included in Appendices 3 and 4.

Water temperatures were obtained at the inshore and offshore ends of each gill net at surface, bottom and 2 m off bottom when nets were set and retrieved, except under severe weather conditions.

Fish residency in the Bruce GS "B" discharge channel prior to operation was investigated on May 1-2. SCUBA divers covered the entire channel under conditions of very slight current and good visibility. These daytime observations were complemented by a single overnight set of the standard experimental gill net in mid-channel near the boat dock.

Length, weight and scale samples were obtained from all salmonids (salmon, trout and whitefish) as well as other game species (walleye and smallmouth bass), with the exception of badly decomposed fish. Sex of round whitefish was determined in the fall. Methodology and verified results of aging of round whitefish, walleye and smallmouth bass will be given in a report covering commissioning and postoperational studies.

2.3 Acoustic Observations of Fish

Acoustic surveys were concentrated on the submerged intake, and intended to show the distribution of fish relative to the intake before and after pumping was initiated (1983 and 1984). We duplicated the grid survey employed in Year I Commissioning Studies (Figure 2-1, insert). Five surveys were conducted in summer with 1 unit in operation: June 26 day and night, June 27 day, and September 11 day and night. Echo data were collected using the high resolution acoustic fish census system (OHRD Report C78-157-K) and survey methods employed at the site in preoperational studies.

Temperature profiles were taken at the corners of the grid and in the intake depression, and additional data were obtained from station intake temperature records. Due to deteriorating weather, the netting and temperature profiles were only obtained in conjunction with the June 26 day and September 11 night surveys.

Echo data analysis for the purpose of this study was limited to qualitative interpretation of the echograms. Fish schools were arbitrarily classed as small or large based on their apparent dimensions on the echograms (from echogram scale relative to transect length), with large schools being 10 m or more in apparent width. Identification of acoustically observed fish species was inferred partially from experimental gill nets set to three sides of the intake depression during the survey. Additional clues were obtained from typical aggregation patterns of pelagic species and from routine gill netting surveys carried out in the same months.

3.0 RESULTS AND DISCUSSION

3.1 Water Temperature and Currents

Seasonal Temperature Regime:

Data from continuous temperature records obtained by G&HE from late April to early December, 1984 are described in G&HE Report No 86180. Three representative locations duplicating those discussed in the Year I Commissioning Biological Studies Report (OHRD Report No 86-166-K) were selected for discussion in this report. Mean daily temperatures at the 3m depth 300 m north of the discharge and along the discharge transect, 1 km offshore at the 2 and 12 m depths are shown in Figure 3-1. Inshore near-surface temperatures rose from 3°C in late April to a maximum of 23°C in early August. The spring-early summer increase in temperature was more erratic than that observed in 1983. Inshore water temperature fluctuated between 5 and 10 °C during May, then rose rapidly to 15°C by the second week of June. However temperatures fell to 9°C during the last half of June before rising again in July.

Large-scale temperature fluctuations of up to 18°C, resulting from wind-driven mass water movements such as upwellings, dominated the thermal history of inshore and near-surface offshore waters from late June to early September. Association of temperature fluctuation with onshore-offshore currents has been demonstrated with 1983 data (OHRD Report 86-166-K). Summer temperature

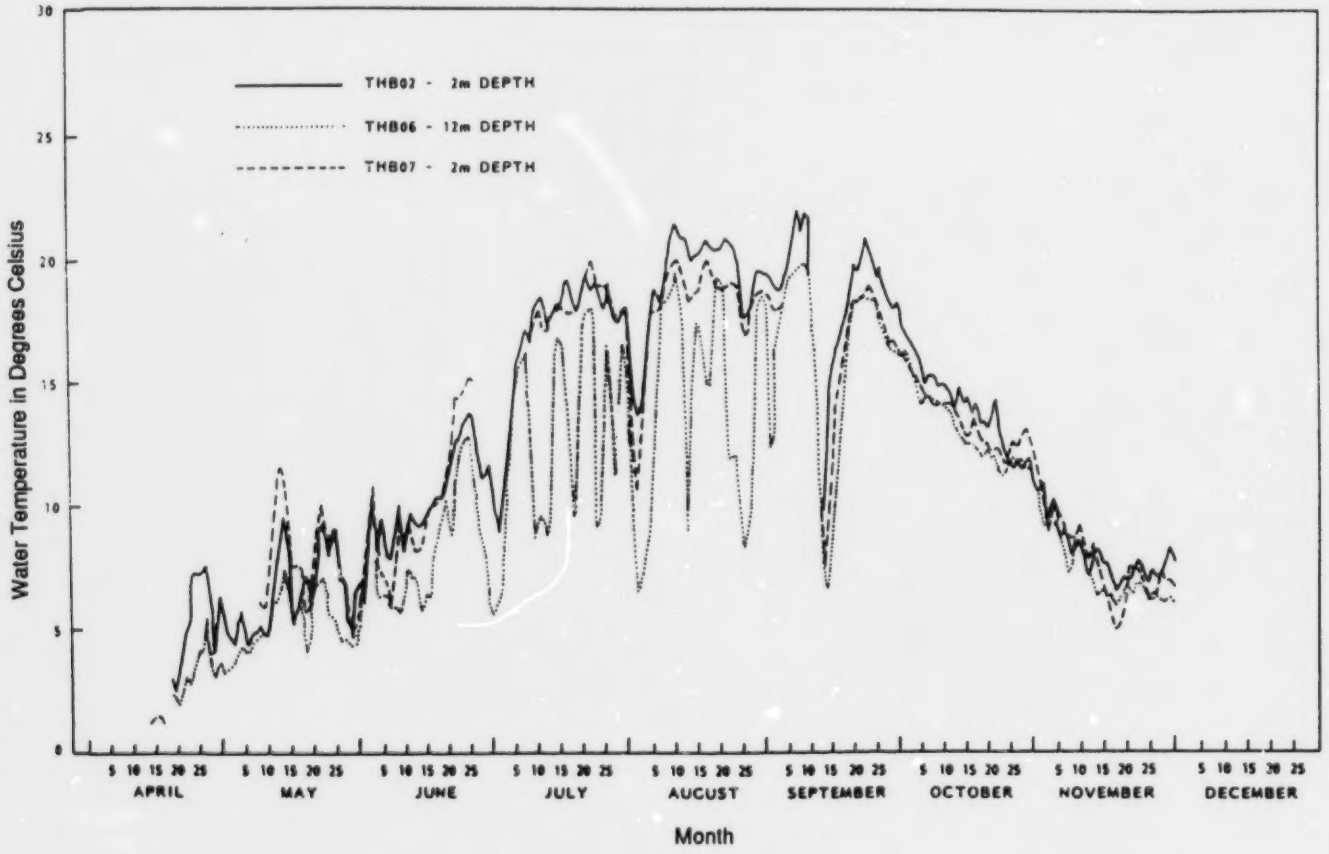


FIGURE 3-1
DAILY MEAN WATER TEMPERATURES AT THREE LOCATIONS
BRUCE G.S. "B", 1984

fluctuations were similar in magnitude, but more frequent than those observed in 1983. Dramatic internal fluctuations of up to 10°C, evident at 12 m but not near the surface, were seen in July and August. Inshore temperatures fell relatively consistently from 18°C in mid-September to 2°C in the second week of December when thermographs were removed.

The influence of the Bruce GS "B" thermal discharge was not apparent at these locations, largely because thermograph THB08, considered representative of the inshore waters at the discharge site in preoperational years, was actually located 300 m north of the discharge groins. In subsequent years this thermograph was moved to a position just off the north discharge groin, to correspond to the inshore end of the "B" discharge netting transect.

Vertical Temperature Structure:

Temperature profiles were obtained approximately monthly at water depths of 3 to 43 m along a line from the north Bruce GS "B" discharge groin by GH&E. These data are described in detail in G&HE Report No 86180. The influence of the one-unit Bruce GS "B" discharge was seen clearly nearest the groins only from July 18 on, although inshore warming relative to offshore surface waters was apparent in earlier months. The vertical and offshore extent of the buoyant warm-water plume produced by Unit 6 alone is illustrated in temperature sections for July 18 and August 9, reproduced in Figure 3-2.

Prominent temperature gradients unrelated to the thermal discharge were absent when profiles were taken before July or after September, but were seen in four temperature profile sets. On two dates, July 18 (Figure 3-2) and September 19, a thermocline was present at approximately 30 m. On August 9 (Figure 3-2) a thermocline separating 21°C and 9°C water intersected the bottom at depths of 12-18 m, which included the cooling water intake and offshore gill net locations. On September 5 (Figure 3-2) a gradient from 13 to 6 °C was observed in the top 10 m of the water column. Figure 3-1 reveals that this was a transitory phenomenon following a major upwelling event.

Additional water temperature measurements were obtained when gill nets were set and retrieved. These values are listed together with the coincident temperature ranges of nearby G&HE thermographs in Appendix 5, and will be discussed later (Section 3.3) in relation to net catches.

Nearshore Currents:

Continuous nearshore current data were obtained by G&HE at 8 m depths 1.6 km off Douglas Point/Bruce Heavy Water Plant (CM05-8) and 1.1 km off Gunn Point (CMB19-8). Detailed descriptions of currents and associated wind data for 1983 and 1984 are given in G&HE Report No 85301. Attention was focused on CM05-8 since it was present in previous years, was midway along the BNPD site, and was in an area in which alongshore flows were less subject to disruption by topographical features. Hourly data relevant to the summer aerial survey and netting are given in Appendix 1.

Currents at CM05 in 1984 were characterized by strong dominance of the northeast alongshore direction, with a ratio of 4:1 for (to the) northeast alongshore vs. southwest alongshore. The maximum duration of a northeast

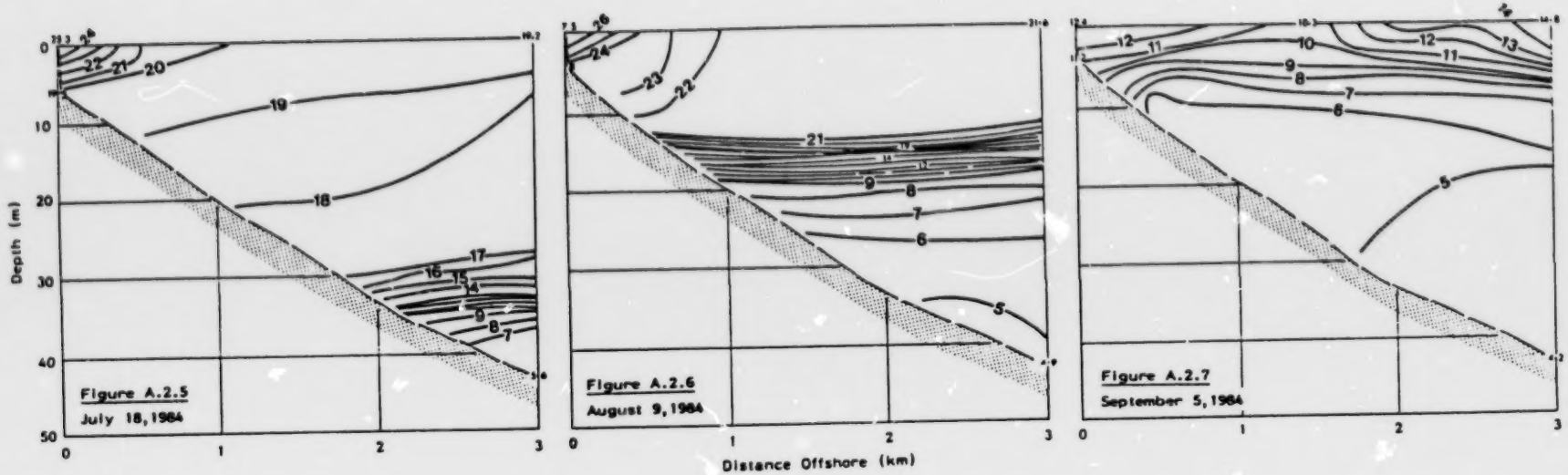


FIGURE 3-2
SELECTED VERTICAL TEMPERATURE SECTIONS OFF THE BRUCE GS "B" DISCHARGE
JULY TO SEPTEMBER, 1984
(REPRODUCED FROM G & HE REPORT NO 86180, FIGS A.2.5, 6, 7)

current episode was 13 days (June 1-14, mean 15 cm/s), as compared to the maximum duration of a southwest current episode of 7 days (Oct 9-16, mean 15 cm/s). Northeast alongshore currents were much more dominant in 1984 than in 1983 (1.5:1 NE:SW alongshore), and the overall occurrence of currents in the northeast quadrant in 1984 (62%) substantially exceeded the long term average of 46% from previous years. The mean current speed of 15 cm/s (Maximum 50 cm/s) recorded in 1984 was also much higher than the 9 cm/s recorded in 1983 or the long-term average of 11 cm/s from previous years, and was outside the range previously recorded at the site.

Because of the higher-than-average persistence of (to the) northeast currents, intrusion of thermal plumes from BNPD facilities north of the Bruce GS "B" study area may have occurred to a lesser degree in 1984 than would normally be expected. The relatively high current activity in 1984 also suggested the possibility of a greater-than-normal degree of wind-induced wave disturbance of the nearshore environment at the site. The shoreline of the Bruce GS "B" site is largely exposed to winds (to the) northeast to southeast. The average wind speed readings in this direction in 1984 (2142 of 5270 hourly readings) was 20.8 km/hr, greater than the average of 18.2 km/hr for 1983 (2213 of 5702 readings; from G&HE Report No 85301, Tables A.9 and B.12) Perhaps more relevant to inshore biota is the finding that the percentage of wind readings which were to the NE-SE and 20 km/hr or more was substantially greater in 1984 than in 1983 (19.8 vs 14.4%). Such winds can produce severe wave action on the Bruce GS "B" study area shoreline.

3.2 Sediment Transport, Substrates and Attached Algae in Relation to the Discharge

To investigate the effect of the extended groins and 1-unit discharge jet on nearshore currents and associated sediment transport, drogue tracking studies (G&HE) and aerial photo surveys were carried out before and after unit 6 start-up and discharge groin extension. A comparison of the discharge groins before and after extension can be made from Figure 3-3.

Drogue Tracking:

Results of the drogue tracking studies carried out on May 2, May 3, August 28 and August 30 are described in a G&HE Technical Memorandum of April 23, 1985. In May no interruption or deflection of alongshore currents was apparent from the drogue tracks. However, it was not possible to determine the path of material moving close to shore towards Bruce GS "B" from the south. High waves prevented the deployment of drogues within 200 m of shore on May 2, when alongshore currents to the northeast were observed. Offshore deflection of drogues by the 1-unit Bruce GS "B" discharge was observed on August 28 and 30. With strong alongshore (approximately 30 cm/s) currents to the northeast (August 28) a surface drogue was deflected almost directly offshore for approximately 300 m at 25 cm/s before resuming a more alongshore direction, while drogues released 200-400 m further offshore showed only a slight change in direction. With lesser (10-15 cm/s) northeast alongshore currents (Aug 30) surface drogues released up to 500 m offshore were deflected 300-500 m offshore at 5-8 cm/s, and had not resumed an alongshore direction at the time of retrieval. Three drogues which approached within 200 m of the south groin were deflected inshore, suggesting the presence of an eddy under these current

A. May 24, 1984

B. September 6, 1984

FIGURE 3-3

THE BRUCE GS "B" DISCHARGE CHANNEL, SEEN FROM THE SOUTH, BEFORE AND AFTER EXTENSION OF THE GROINS

176446-B21-RD

conditions. The inward movement of two of the drogues began far enough offshore that it appears certain that it was related to the presence of the discharge jet.

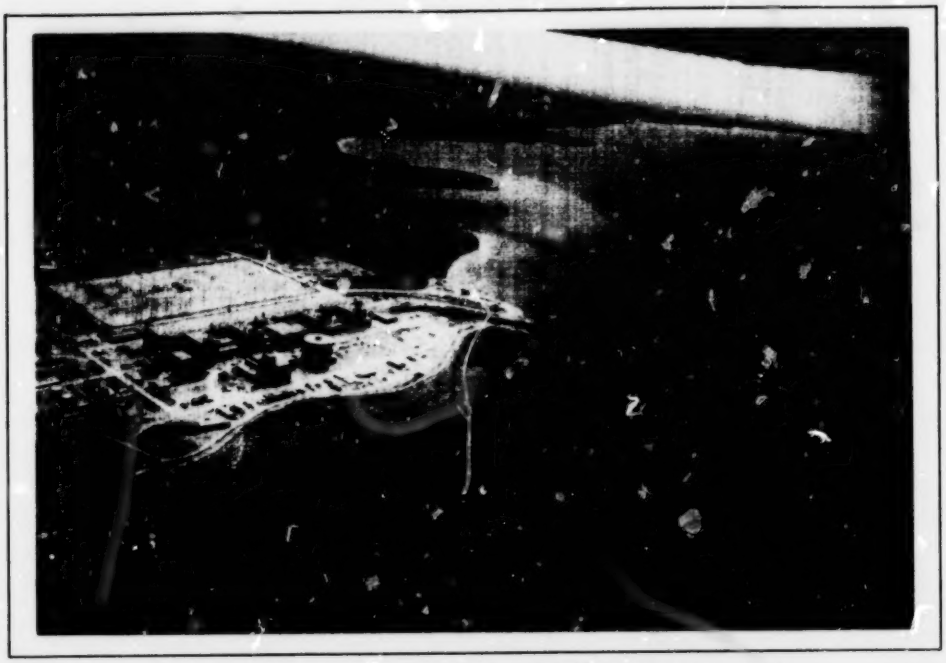
Aerial Photography:

Aerial surveys were initiated at the beginning of stormy weather when there was the greatest probability of observing developing turbidity patterns. Photographs of the Bruce "B" site taken on May 24 at approximately 11 am (Figure 3-4) show a prominent turbidity plume arising from the shoreline of Gunn Point and adjacent Inverhuron Bay, apparently resulting from erosion of shoreline fine substrates by wave action. The plume is shown sweeping northward and fanning out as it crosses the mouth of Holmes Bay, but does not extend far enough north to allow inferences concerning currents in the area of the discharge. Evidently there was minimal erosion of material from the shoreline and discharge groins of Bruce GS "B", which were protected by armour stone. Currents at CM05-8 (1 km off BHWP) and CMB19-8 (off Gunn Point) prior to and during the May aerial survey were alongshore to the northeast, and were increasing throughout May 24 (Appendix 1).

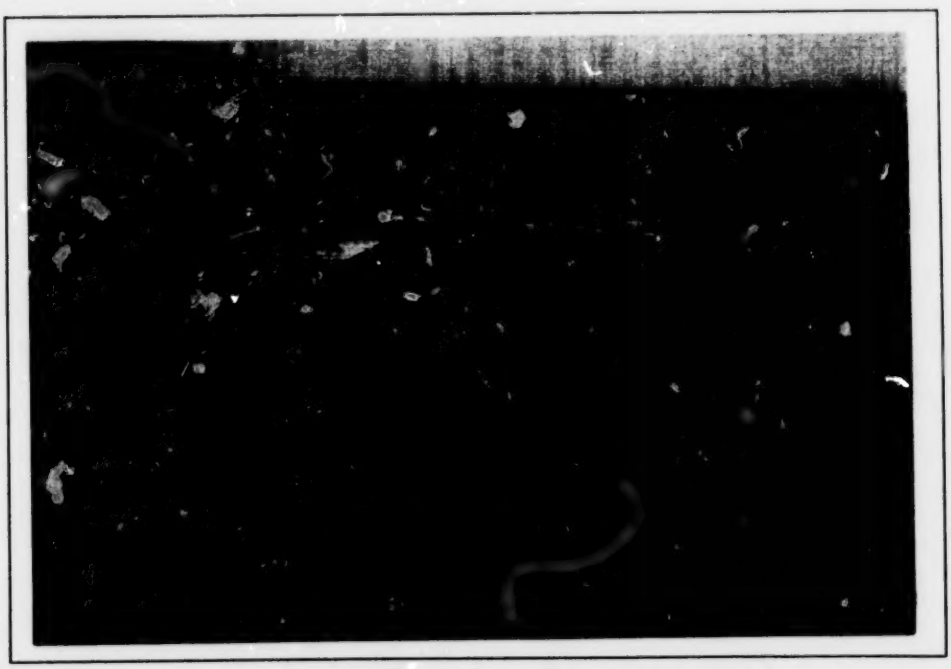
Secchi depth measurements were initiated to the north of the Bruce GS "B" site on May 24, but were discontinued south of the "B" discharge transect due to increasingly rough seas, preventing correlation with the observed plume. Secchi depth ranged from 3 m at the 3 and 7 m contours off the Bruce GS "A" discharge to 5.4 m immediately in front of the "B" discharge groins. Bruce GS "B" unit 6 became critical on May 29, so that pumping may have been underway during these observations. The higher transparency could have resulted from discharged water if pumping tests were occurring, but a relatively clear discharge jet is not apparent in the photographs. No obvious turbidity patterns were present during the aerial survey of September 6, following completion of the groins and with 1-unit operation. Current direction and speed during and prior to aerial photography and drogue tracking are given in Appendix 1.

Substrates:

Dominant substrates observed within 1 km north and south of the discharge groins in early June and late August are compared in Figure 3-5 (detailed data by 50 m transect segments are given in Appendix 2). The two surveys gave somewhat similar results, the most obvious difference being increased predominance from June to August of exposed bedrock on the 5 m contour near the south groin. A change to exposed bedrock from boulder substrate is not likely to have resulted from changing current patterns produced by the groins and discharge jet. Deviation in the survey line is the most plausible explanation, although boulders could also have been shifted by severe wave action. Since the principal concern relates to potential fine substrate build-up, the uncertainty over apparent changes in boulder and bedrock distribution is relatively unimportant.



A. View from the North, Bruce GS "B" in Foreground

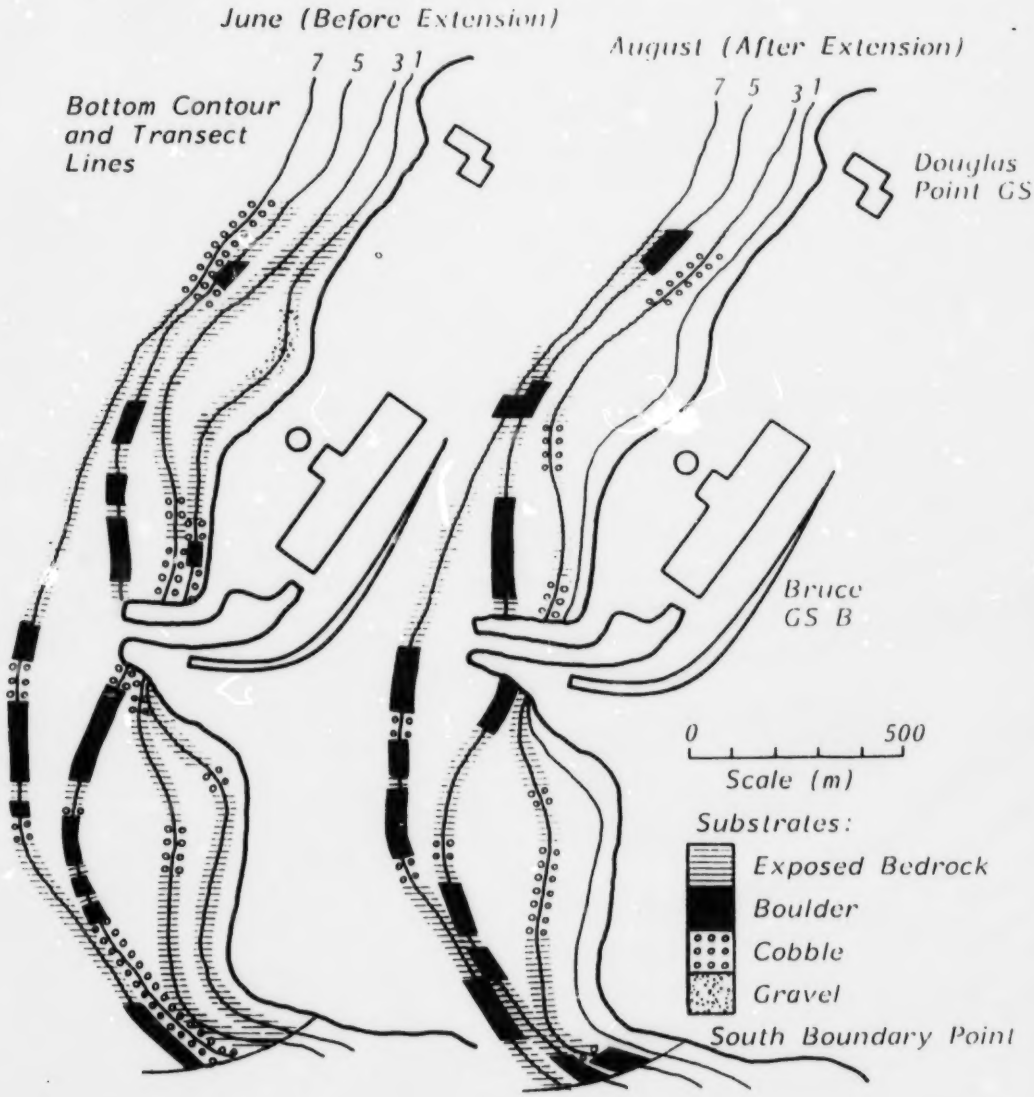


B. View from the South, Gunn Point in Foreground

FIGURE 3-4

AERIAL VIEWS OF THE BRUCE GS "B" AND BNPD SITES SHOWING A TURBIDITY PLUME ORIGINATING FROM THE GUNN POINT - INVER HURON BAY SHORELINE

176447-B22-RD



Note: - Actual transect lines may deviate by up to ± 30 m from illustrated contours

FIGURE 3-5

DOMINANT SUBSTRATES IN THE VICINITY OF THE BRUCE GS "B" DISCHARGE IN JUNE AND AUGUST, 1984 BEFORE AND AFTER GROIN EXTENSION

176678-RD

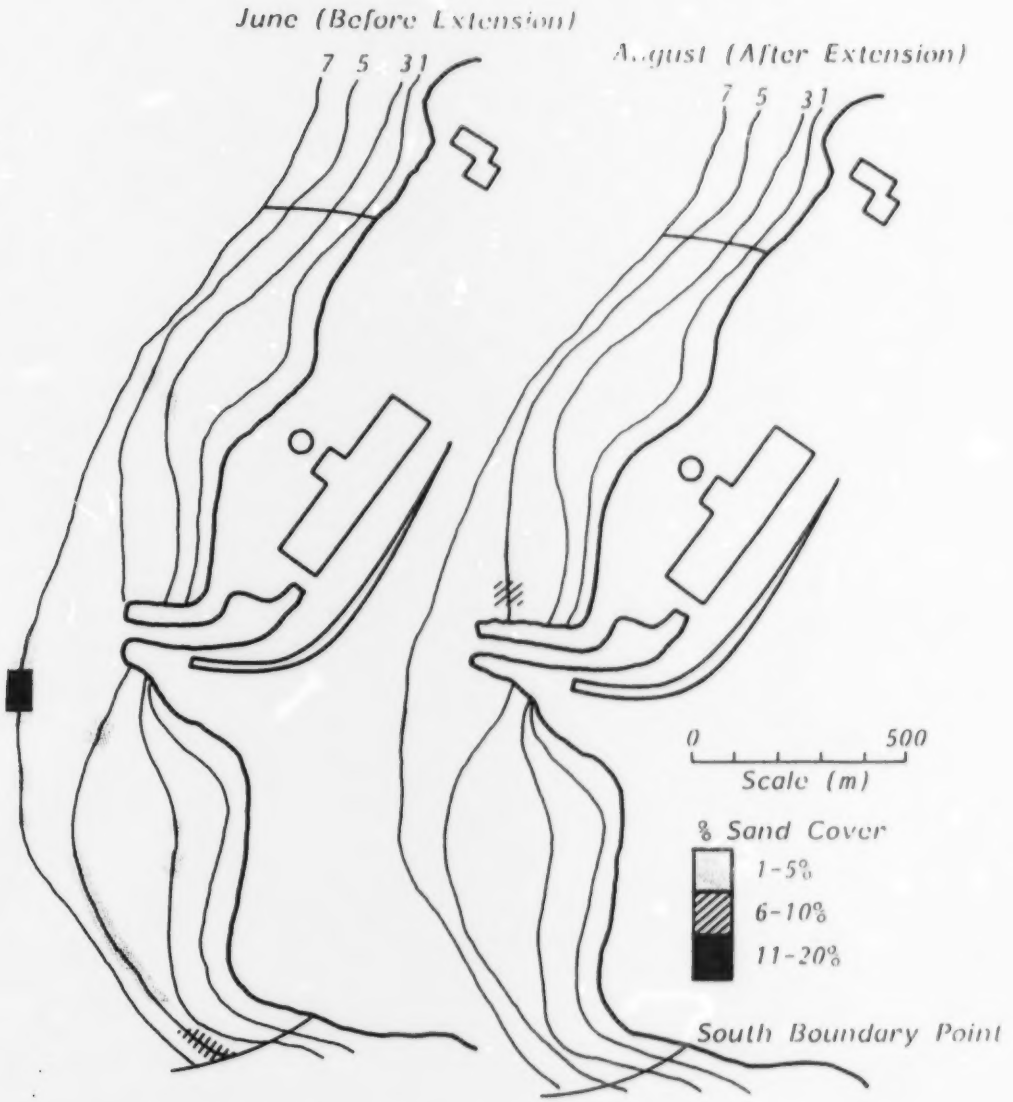
The distribution of fine substrates was examined in order to identify any accumulations resulting from interruption of alongshore transport of material by the completed discharge groins and jet. Figure 3-6 compares the per cent cover of sand in June and August. In both sampling periods sand was found on a minority of segments, usually covering 5% or less (never more than 20%) of the bottom. Silt cover was either absent, or of insufficient thickness to obscure underlying substrates. From June to August two changes were apparent in the distribution of what little sand was present: most of the sand present at 3-7 m south of the discharge disappeared, possibly as a result of wave action, while a small accumulation appeared along the 5 m contour within the first 200 m north of the groins. The latter possibly accumulated due to its position in the lee of the groins relative to prevailing alongshore currents to the northeast, but cover did not exceed 10% of the bottom. Similar accumulations were not apparent at the 7 and 3 m contours (the 1 m contour was missed in August). No appreciable accumulation of silt, as might be expected to be deposited by eddy currents, was found in the vicinity of the groins on either date. A film of silt less than 1 mm in thickness covered the coarser substrates at the 5 and 7 m depths in June, while in August a 1-2 mm covering of silt was found along the 7 m contour only, again pointing to the effects of wave action at shallower depths.

The composition of the substrate and the relative importance of fine substrate in the area examined did not differ appreciably from preoperational years, when boulder and exposed bedrock predominated and sand did not exceed 6% cover at any sampling point in the vicinity of the discharge (OHRD Report No 83-507-K). The only major accumulation of sand in the Bruce GS "B" study area was found in Inverhuron Bay.

The inshore topography in the vicinity of the discharge may be significant in terms of material accumulation and fish spawning. Shallow (<5 m) bedrock ledges and ridges extend several hundred meters offshore immediately south of the groins and along much of the shoreline off the BNPD site, but are conspicuously absent for approximately 200 m north of the discharge (Aerial views, Figures 3-4 and 3-5). South of the discharge the shallow bedrock includes roughly circular formations which may represent areas of solution by groundwater percolating into the lake (J. Grass, G&HE, pers. comm.). Such features have been utilized by lake whitefish for spawning elsewhere (attributed to P. Sly, Environment Canada, by ESSA, 1986), and may be attractive to other lake-spawning species such as lake trout (Nester and Poe, 1987).

Attached algae:

During the June SCUBA investigations of substrate, attached filamentous algae of 1-2 cm length were observed covering most of the armour stone at the 1 m depth. However, on the natural substrates adjacent to the armour stone growth was limited to less than 5% cover, being confined to isolated pockets in the bedrock or inshore of large boulders. In those areas filamentous algae up to 1.5 cm in length and healthy in appearance were found. This lack of algae at shallow depths may be attributed to the effect of wave action.



Note: - Actual transient lines may deviate by up to ±30 m from illustrated contours
- (Silt occurred only at 3 mm trickness - Refer to text for distribution)

FIGURE 3-6

DISTRIBUTION OF FINE SUBSTRATE (SAND) IN THE VICINITY OF THE BRUCE GS "B" DISCHARGE IN JUNE AND AUGUST, 1984, BEFORE AND AFTER GROIN EXTENSION

176679-RD

Along the 3 m contour cover of filamentous algae was nearly complete on bedrock and stones ranging down to cobble, but sparse on smaller substrates. Algal strands were 1-2 cm long and appeared dark green and healthy. Along the 5 m contour green-brown growth approximately 1 cm long was present on all substrates, while at 7 m growth was brown and 0.5 cm or less long. The brown colour at the greater depths may have been due at least in part to the presence of dead algae or other detritus on the growth. Such material has been found to be common at depths greater than 3 m, resulting in problems in the interpretation of algal biomass measurements (eg. OHRD Report 82-107-K).

There were no obvious changes in algal distribution and appearance at the 3, 5 and 7 m contours from June to August. The lack of an increase in strand length from June to August may have been due to breakage by wave action, poor growth due to low nutrients, or a combination of both factors.

3.3 Adult and Juvenile Fish Distribution

Fish Community Composition, May to November:

In 1984 the nearshore fish community was sampled by gill nets only. The composition of the catch for the standard open water period of May to November is compared to the gill net catch of 1983 (Commissioning Year I) in Table 3-1. Data for 1984 exclude September, for which catch records were lost, with the exception of salmonid and game species which were also recorded on scale envelopes. Total catches including September are shown in parentheses for those species.

The 1984 May-November catch, excluding September, consisted of approximately 6000 fish of 27 species. The number of species decreased from the 33 recorded for the 1983 gill net catch, but the list of species contributing 1% or more to the catch (11 in 1983, 12 in 1984) was virtually identical. Alewife contributed approximately 25% of the catch, while longnose sucker, gizzard shad and yellow perch each contributed more than 10%. The largest year-to-year change in species composition was in the relative importance of alewife. Alewife catches (both total numbers and average catch-per-unit effort (CUE), Table 3-2) were substantially reduced in 1984 in comparison to 1983 and preoperational years (OHRD Report No 87-185-K). Factors which may have contributed to decreased annual alewife catches include actual population changes, timing of sampling relative to temperature fluctuations in the nearshore area, and increased wave disturbance during sampling periods (field crews' casual observations). The latter could have affected both fish abundance and gear efficiency. Round whitefish was the other major species to show a marked decline in catch (approximately 50% in average CUE), while gizzard shad, rainbow smelt and burbot catches increased. Trends in abundance of major fish species over the preoperational and commissioning periods are examined in the Commissioning Year IV and Summary Report (in draft).

Fish Community Composition, December:

Winter fishing in 1984 was limited to December, with the results shown as part of the seasonal catch summaries in Tables 3-2 and 3-3. The remaining winter months were sampled in later commissioning study years. The December catch in

TABLE 3-1

TAXONOMIC COMPOSITION OF MAY-NOVEMBER GILL NET CATCH
BRUCE GS "B", 1983 AND 1984

FAMILY AND SPECIES Common Name (Scientific Name)	1983 No.	 %	1984 No.	 %
Lampreys (Petromyzontidae):				
Species unidentified	2	<0.1		
Gars (Lepisostaidae):				
Longnose gar (*Lepisosteus osseus*)			1	<0.1
Herrings (Clupeidae):				
Alewife (*Alosa pseudoharengus*)	4311	44.1	1655	27.6
Gizzard shad (*Dorosoma cepedianum*)	707	7.2	769	12.8
Salmonids (Salmonidae):				
Pink salmon (*Oncorhynchus gorbuscha*)	2	<0.1		
Coho salmon (*Oncorhynchus kisutch*)	1	<0.1	5(6)*	<0.1
Chinook salmon (*Oncorhynchus tshawytscha*)	1	<0.1	3	<0.1
Rainbow trout (*Oncorhynchus mykiss***)	14	0.1	(1)	
Brown trout (*Salmo trutta*)	1	<0.1	1	<0.1
Lake trout (*Salvelinus namaycush*)			4	<0.1
Splake (*S. namaycush X S. alpinus*)	2	<0.1	(1)	
Cisco (*Coregonus artedii*)			3	<0.1
Lake whitefish (*Coregonus clupeaformis*)	1	<0.1	4	<0.1
Round whitefish (*Prosopium cylindraceum*)	341	3.5	113(129)	1.9
Smelts (Osmeridae):				
Rainbow smelt (*Osmerus mordax*)	130	1.3	472	7.9
Pikes (Esocidae):				
Northern pike (*Esox lucius*)	1	<0.1		
Minnows (Cyprinidae):				
Longnose dace (*Rhynichthys cataractae*)	2	<0.1		
Lake chub (*Couesius plumbeus*)	379	3.9	111	1.9
Carp (*Cyprinus carpio*)	10	0.1	5	<0.1
Common shiner (*Notropis cornutus*)	1	<0.1		
Emerald shiner (*Notropis atherinoides*)			1	<0.1
Spottail shiner (*Notropis hudsonius*)	347	3.6	185	3.1
Suckers (Catostomidae):				
Longnose sucker (*Catostomus catostomus*)	1312	13.4	850	14.2
White sucker (*Catostomus commersoni*)	710	7.3	504	8.4
Redhorse sucker (*Moxostoma sp.*)	47	0.5	18	0.3
Catfish (Ictaluridae):				
Brown bullhead (*Ictalurus nebulosus*)	1	<0.1	1	<0.1
Channel catfish (*Ictalurus punctatus*)	69	0.7	84	1.4
Cods (Gadidae):				
Burbot (*Lota lota*)	270	2.8	338	5.6
Trout-perches (Percopsidae):				
Trout-perch (*Percopsis omiscomaycus*)	23	0.2	10	0.2
Temperate basses (Percichthyidae):				
White bass (*Morone chrysops*)	22	0.2	30	0.5
White perch (*Morone americana*)	2	<0.1		
Sunfishes (Centrarchidae):				
Rock bass (*Ambloplites rupestris*)	5	<0.1		
Smallmouth bass (*Micropterus dolomieui*)		0.3	7	0.1
Perches (Percidae):				
Yellow perch (*Perca flavescens*)	897	9.2	676	11.3
Walleye (*Stizostedion vitreum*)	108	1.1	121(134)	2.2
Sauger (*Stizostedion canadense*)	1	<0.1	2	<0.1
Drums (Sciaenidae):				
Freshwater drum (*Aplodinotus grunniens*)	12	0.1	17	0.3
TOTAL CATCH	9766		5990	
NO OF SPECIES	33		27(29)	

* Total including September catch given in parentheses where available
** formerly *Salmo gairdneri*

TABLE 3-2

CATCH-PER-UNIT-EFFORT OF MAJOR FISH SPECIES
IN 3.8 - 12.7 cm MESH GILL NETS BY MONTH AND DEPTH

SPECIES	CUE							MAY-NOV		DEC (WINTER)	
	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	CUE	%	CUE	%
3 m:											
Alewife	5.6	67.7	4.0	39.4		0.1		17.2	33		
Longnose Sucker	7.1	12.2	3.4	12.0		2.3	5.6	6.6	13	0.8	4
Yellow Perch	0.9	0.5	21.1	5.6		1.6		4.6	9	0.8	4
White Sucker	1.5	2.6	11.5	6.4		2.4	8.2	4.6	9	5.6	29
Gizzard Shad	0.3	0.1	0.1	0.2		46.1	0.6	10.5	20	1.2	6
Round Whitefish	1.0	0.6			(0.7)*	2.3	4.4	1.2 (1.3)	2	2.4	13
Burbot	2.2	7.6		0.2		1.1	0.6	2.2	4	3.8	20
Walleye			1.1	0.6	(1.1)	5.1	5.4	1.8 (1.7)	3	1.0	5
Others	1.2	1.7	1.1	7.8		5.4	5.4	3.3	6	3.4	18
Total CUE	19.1	93.0	42.3	72.2		66.4	30.2	52.0		19.0	
No. of Days Set	15	10	10	5	(10)	13	5	58 (68)		5	
12 m:											
Alewife	6.5	42.2	1.2	18.8				10.6	29		
Longnose Sucker	4.1	3.7	14.8	3.8		8.4	17.4	7.9	21	4.8	21
Yellow Perch	0.1	2.3	20.6			8.1	0.2	6.0	16	1.6	7
White Sucker	0.5	0.3	11.0	0.2		5.6	7.4	4.0	11	8.6	37
Gizzard Shad			0.2			11.2	0.2	2.7	5		
Round Whitefish	1.2	1.2			(0.9)	0.4	0.8	0.7 (0.8)	2	0.8	3
Burbot	4.8	6.2	0.6	3.8		2.9	1.6	3.5	9.5	6.2	27
Walleye			0.3		(0.3)	0.6	0.4	0.2	0.5		
Others	0.1	0.2	0.8	2.0		2.9	1.8	1.3	3.5	1.2	5
Total CUE	1 .0	56.1	49.5	28.6		40.1	29.8	36.9		23.2	
No. of Days Set	15	10	10	5	(10)	14	5	54 (64)		5	
3 + 12 m:											
Alewife	6.0	55.0	2.1	29.1				13.8	31		
Longnose Sucker	5.6	8.0	9.1	7.9		5.4	11.5	7.3	16	2.8	13
Yellow Perch	0.5	1.4	20.9	2.8		5.0	0.1	5.3	12	1.2	6
White Sucker	1.0	1.5	11.3	3.3		4.0	7.8	4.3	10	7.1	34
Gizzard Shad	0.1	0.1	0.2	0.1		28.0	0.4	6.6	15	0.6	3
Round Whitefish	1.1	0.9			(0.8)	1.3	2.6	1.0 (1.0)	2	1.6	8
Burbot	3.5	6.9	0.3	2.0		2.1	1.1	2.9	7	5.0	24
Walleye			0.7	0.3	(0.7)	2.8	2.9	1.0 (1.0)	2	0.5	2
Others	0.7	1.0	1.3	4.9		4.2	3.6	2.2	5	2.3	11
TOTAL CUE	18.5	74.6	45.9	50.4		52.8	30.0	44.4		21.1	
No. of Species	11	12	16	11		20	15	25		13	
No. of Days Set	30	20	20	10	(20)	27	10	117 (137)		10	

* CUE values for September or including September are shown in parantheses for applicable species.

TABLE 3-3

CATCH-PER-UNIT-EFFORT OF MAJOR FISH SPECIES
IN 2.5 cm MESH GILL NETS BY MONTH AND DEPTH

SPECIES	CUE						MAY-NOV		DEC (WINTER)	
	MAY	JUNE	JULY	AUG	OCT	NOV	CUE	%	CUE	%
3 m:										
Spottail Shiner	3.7	1.6	2.2		0.6	0.2	1.6	26	0.2	4
Lake Chub	1.2	0.1	2.9	2.4	0.2	0.4	1.1	18		
Alewife	0.1	3.0		0.2	0.1	0.2	0.6	10		
Rainbow Smelt	0.3	0.7		17.0	0.7	0.6	1.9	30	3.8	76
Others	0.1	0.2	0.6	8.4	0.2		1.0	16	1.0	20
Total CUE	5.3	5.6	5.7	28.0	1.8	1.4	6.2		5.0	
No. of Days Set	12									
12 m:										
Spottail Shiner	0.4	1.4	7.1		0.1		1.6	20	0.2	10
Lake Chub			0.9	3.0	0.4		0.5	6		
Alewife		0.6		0.4	0.1	0.2	0.2	3		
Rainbow Smelt	0.1	1.0	0.5	57.6	0.6	0.4	5.3	67	0.6	30
Others		0.4	0.8	0.6	0.2		0.3	4	1.2	60
Total CUE	0.5	3.4	9.3	61.6	1.4	0.6	7.9		2.0	
	15									
3 + 12 m:										
Spottail Shiner	1.8	1.5	4.7		0.4	0.1	1.6	23	0.2	6
Lake Chub	0.5	0.1	1.9	2.7	0.3	0.2	0.8	11		
Alewife		1.7		0.3	0.1	0.2	0.4	6		
Rainbow Smelt	0.2	0.8	0.3	37.3	0.7	0.5	3.7	52	2.2	63
Others	0.1	0.4	0.6		0.1		0.6	8	1.1	31
TOTAL CUE	2.7	4.4	7.5	44.8	1.6	1.0	7.1		3.5	
No of Species	6	6	8	5	7	4	12		5	
No. of Days Set	27	19	20	10	27	10	114		10	

(C107)

3.8-12.7 cm mesh nets was dominated by white sucker (34%), followed by burbot and round whitefish. Rainbow smelt contributed the bulk of the catch (63%) in 2.5 cm mesh nets. Round whitefish were the most common species in December, 1983 catches, and the decrease in December catch of this species in December 1984 followed their decreased contribution to the May - November catch. The predominance of rainbow smelt in small mesh nets in 1984 was not seen in December, 1983, again reflecting the change in importance of this species in May - November catches.

Temporal Variation in Nearshore Fish Abundance at Shallow and Deep Locations:

Catch-per-Unit Effort (CUE) in gill nets was used to provide an index of abundance for examination of temporal and spatial trends. Seasonal variation in the CUE of eight major fish species in 3.8-12.7 cm mesh gill nets is shown by depth (transacts combined) in Table 3-2. At both the 3 m and 12 m depths, peak abundance for most species occurred in spring or early summer. Alewife and burbot abundance peaked in June, decreased markedly in July and returned to relatively moderate levels in August. Longnose sucker followed a slightly different pattern, as overall (both depths combined) CUE remained essentially similar from May to August while depth distribution varied strongly by month. July produced the highest deep set catches, but the lowest shallow set catches. In contrast to these species, yellow perch and white sucker reached peak abundance in July at both depths. Abundance of the remaining species shown in Table 3-2 peaked in October (gizzard shad) or November (round whitefish and walleye).

Seasonal variation in catch of the five most common species taken in 2.5 cm mesh nets is shown in Table 3-3. Spottail shiner and lake chub were most frequently caught, but rainbow smelt were numerically dominant overall as a result of substantial catches in both deep and shallow sets in August.

Seasonal trends in abundance of the major species appeared generally similar to those observed in 1983, although there were notable differences in summer distribution. While shallow 3.8-12.7 cm mesh catches of alewife and longnose sucker were higher in August than July in 1984, the reverse was true in 1983. A reversal was also seen in catches of yellow perch and white sucker, which declined from July to August in 1984 but increased in 1983. In addition, burbot were rare at either depth in August of 1983. Similarly, the principal difference between 1984 and 1983 in 2.5 cm mesh occurred in the summer distribution of rainbow smelt; substantial catches (10+ fish/set) were made in both shallow and deep sets in 1984, but in the deep sets only in 1983.

These differences in fish distribution may be explained by temperature selection of species preferring relatively cold, cool or warm summer temperatures (as given by Spotila *et al*, 1979, and as suggested by historical trends in seasonal depth distribution at the BNPD site). Evidence for this hypothesis can be obtained from temperatures obtained at the nets during setting and retrieval (Appendix 5). In 1984 both the shallow nets and the deep nets were set in substantially colder water in August than in July. The temperature ranges in the shallow nets, set at 3 m at the inshore end and 5-7 m at the offshore end, were 9-16°C in August and 18-22.5°C in July. Corresponding temperature ranges at the deep nets, set at 12 m at the inshore end and 14-17 m at the offshore end, were 7.5-16.5°C and 17.5-20°C.

Figure 3-1 (Section 3.1) indicates a major upwelling event in mid-August just prior to netting, followed by depressed inshore temperatures and strong internal oscillations at depths of 3-12 m during the netting days. This did not occur in 1983 when inshore nets were exposed to slightly colder water in July and subsequently to substantially warmer water in August. Temperatures measured at the deep nets were also generally higher in August than in July in 1983, although offshore portions of the nets were intermittently exposed to colder water.

From the comparison of fish distribution with summer temperatures, it is apparent that in 1984 both the normal offshore migration of longnose sucker and alewife, which prefer relatively cool temperatures in summer, and the appearance of yellow perch and white sucker, which prefer warmer temperatures in summer, occurred early, but were reversed in August due to the upwelling of cold water. The upwelling also resulted in the appearance of rainbow smelt, which prefer cold water, in the shallow sets, and of burbot, which apparently have an even lower temperature preference, in the deeper sets. Nearshore appearance of another coldwater species, the bloater (*Coregonus hoyi*), in summer during upwelling of cold water has been described for Lake Michigan by Jude *et al* (1979). The distribution of catches of the major species relative to temperature will be examined in greater depth in the Commissioning Year IV and Summary Report (in Draft).

The only comparable fish abundance data from other nearshore locations in northeastern Lake Huron is found in the results of the MNR index fishing program at Oliphant, approximately 50 km north of BNPD (MNR, 1986). Nets fished were similar to ours in mesh size (3.8-12.7 cm) and material, but panels were of varying length and CUE was calculated on the basis of No/1000m of net/24 hr set. Thus species composition is readily comparable to that in our 3.8-12.7 cm mesh catches, but CUE is not. Depths from 15 to 55 m were fished in June and September only. In June alewife were most abundant (3.8 cm mesh size effort corrected), followed by bloater. Moderately abundant species included longnose sucker, lake whitefish and lake herring. Rainbow smelt, burbot, yellow perch, white sucker and round whitefish were taken in smaller numbers. In September gizzard shad appeared in significant numbers and smelt and yellow perch increased greatly, with smelt becoming dominant. Of the coregonids, bloater and round whitefish increased in abundance in September, while lake whitefish and lake herring decreased. 1984 marked the first year in which white bass appeared in the gill net catch at Oliphant.

The species composition at Oliphant was generally similar to that observed at BNPD in 3.8-12.7 cm gill nets in June and September in 1984. The principal differences were in the greater importance of some coregonid species, particularly bloater, a deepwater cisco species not yet identified in our sampling. In addition, white suckers appeared less important at this site. These differences can be explained at least in part by the greater depths sampled at Oliphant (inshore ends at 15-55 m vs 3-12 m at BNPD).

Alongshore Variation in Nearshore Fish Abundance:

Alongshore variation was assessed using transect averages of monthly CUE values for the eight common fish species taken in 3.8-12.7 cm nets (Table 3-4). All species but walleye were distributed roughly evenly from north to

TABLE 3-4

ALONGSHORE VARIATION IN CATCH-PER-UNIT-EFFORT
OF MAJOR FISH SPECIES IN 3.8-12.7 CM MESH GILL NETS

SPECIES	TRANSECT				
	DOUGLAS POINT	BRUCE GS 'B' DISCHARGE	BRUCE GS 'B' INTAKE	HOLMES BAY	GUNN POINT
Alewife	12.5	16.4	10.3	16.4	14.3
Longnose Sucker	9.4	5.7	7.7	5.4	8.2
Yellow Perch	4.5	3.5	4.5	7.0	7.3
White Sucker	5.6	3.0	3.1	4.7	5.1
Gizzard Shad	4.3	5.3	7.2	8.4	7.8
Round Whitefish*	1.1 (1.2)	1.2 (1.1)	0.6 (0.7)	1.2 (1.1)	0.4 (0.4)
Burbot	3.1	2.1	2.5	2.4	4.3
Walleye*	1.5 (1.3)	2.1 (2.0)	0.9 (0.7)	0.3 (0.3)	0.3 (0.5)

* CUE values in parentheses include September.

south. Most walleye were caught on the two northern transects, Douglas Point and Bruce "B" discharge, which would be most likely to be influenced by heated BNPD plumes.

Fish Residence in the Discharge Channel and Plume:

Fish occurring in the Bruce "B" discharge channel were surveyed on May 1-3 by SCUBA divers and by gill net, as a contribution to preoperational data (dives with the station operating were conducted in later commissioning years). On May 1 divers encountered a slight, unheated flow in the discharge channel. They noted that the bottom was generally silt-covered, with the exception of a sandy area at the bend opposite the dock area. Numerous dead gizzard shad were seen on the bottom, but the only living fish observed were one rainbow smelt and three slimy or mottled sculpin. Subsequently, a single 24-hr set of the standard experimental gill net (2.5 - 12.7 cm mesh) produced a total of 70

fish of 6 species (Table 3-5). Rainbow smelt were numerically dominant, which suggests that the lake sampling two weeks later missed the peak inshore abundance of this species.

TABLE 3-5

FISH CATCH IN THE BRUCE GS "B" DISCHARGE CHANNEL MAY 2, 1984

Species	No. Caught	Per cent
Gizzard shad	5	7
Rainbow smelt	24	34
Spottail shiner	15	21
Longnose sucker	18	26
White sucker	6	9
Trout-perch	2	3
Total	70	

The mortality of gizzard shad observed by divers could have involved cold stress, particularly if the shad had been displaced from heated discharges to the north (Cox and Coutant, 1976; OHRD Report No 77-400-K). However, this cannot be verified since the time of the mortality and the thermal history of the fish are unknown.

Previously, netting in the Bruce GS "B" discharge channel had only been carried out in late fall and winter as part of a special study (OHRD Report No 81-308-K). Those samples produced small numbers of several fish species common to the site, the most abundant being gizzard shad and white sucker.

Concentration of walleye on the discharge and Douglas Point transects (Table 3-4) suggested that this species may have been residing in heated waters. Most walleye were caught at 3 m locations in October and November (Table 3-2). In these months nets at the 3 m discharge and Douglas Point locations were elevated by 1-2^{o}C in comparison to locations further south (Appendix 5), and accounted for 84% of walleye in the 3 m sets.

In December two units of Bruce GS "B" were operating and sinking plume conditions were present as ambient temperatures (on the two southern transects) ranged from 2.5 to 4^{o}C. Temperatures were elevated by 1-2^{o}C in both deep and shallow sets on the Douglas Point and Bruce "B" intake transects and by 2-4^{o}C on the Bruce "B" discharge transect. The 5 walleye taken in December were caught on the three heated transects, continuing the trend observed in October and November. Other species common from October to December, including round whitefish, occurred in roughly similar numbers in heated and unheated areas.

It should be noted that, based on the observed temperature distribution from probe data associated with fishing and from meter THB08-3, the bulk of temperature elevation observed in the Bruce GS "B" study area through 1984 was probably contributed by discharges north of the site.

3.4 Biology of Selected Fish Species

Round Whitefish (*Prosopium cylandraceum*):

From May to December a total of 145 round whitefish was taken in gill nets in the Bruce GS "B" study area. Scale samples, lengths and weights were taken from 134 of these. The overall range in fork length in 1984 was 30 to 48 cm (Table 3-6). Mean lengths were only slightly less in 1983, when a few smaller fish (minimum 20 cm) were caught. In both commissioning years mean lengths were about 2 cm greater during the fall reproductive period than in spring, and this could simply have represented summer growth.

While the overall size range of round whitefish caught further north at Oliphant in 1982 and 1983 (MNR, 1984) was similar to that at BNPD in 1983, the means were smaller since they included substantial numbers of juveniles. Mean lengths were also lower in fall when age 1 fish (approximately 16-20 cm in length) were large enough to be taken in 3.8 cm mesh net panels. Juveniles of that size were rare at the Bruce GS "B" site. A possible explanation is that these fish remained in deeper waters; the MNR netting survey sampled waters 15-50 m deep, while our 12 m nets sampled a maximum depth of 15-16 m at the offshore ends.

Distribution and characteristics of round whitefish caught just prior to or during the fall reproductive period in commissioning years 1983 and 1984 are summarized in Table 3-7. In both years approximately 80% of round whitefish caught at this time were taken in the shallow (3-7 m) nets. These inshore catches occurred on all transects, although Holmes Bay was marginally more productive than the others. In 1983 the percentage of post-spawn females rose from 0 to 94 between November and December sampling periods, indicating that spawning must have occurred during that time. In 1984 (when reproductive condition was not noted) an abrupt decrease of approximately 15% in average female condition factor (CF = weight in grams/(fork length in cm)^3 x 100), suggestive of spawning, again occurred between November and December sampling periods. From November to December sampling dates minimum inshore water temperatures fell from 5 to 3°C in 1983 and from 7 to 2°C in 1984, into the range at which spawning occurs in Lake Ontario (Haymes and Kolenoski, 1984). However, in 1981 spawning at BNPD was apparently completed by the time inshore temperatures reached a slightly higher 4°C (OHRD Report No 83-451-K).

Walleye (*Stizostedion vitreum vitreum*):

Walleye began to appear at the site in July, well after their reproductive period, and peaked in abundance in October. Of 139 walleye caught from July to December, 86 were processed for length, weight and scale samples (a number of fish frozen on site for later examination were spoiled as a result of a power outage). All fish were adults ranging in fork length from 34 to 70 cm. Largest numbers were 36-39 cm, although the length distribution was relatively even from 36 to 55 cm (Figure 3-7). This differed somewhat from 1983, when the largest number were 48-49 cm, and few fish were less that 40 cm. The absence of walleye at the site at the time of their spring reproductive season has been noted during earlier years.

TABLE 3-6

COMPARISON OF FORK LENGTHS OF ROUND WHITEFISH FROM BNPD AND OLIPHANT (MNR) GILL NETTING SURVEYS

	BNPD, 1983-84			
	JAN-JUNE 83	JUL-DEC 83	JAN-JUNE 84	JUL-DEC 84
NO	70	266	48	82
MEAN-CM	35.93	38	37.55	39.56
ST DEV	4.17	4.61	2.53	3.53
MIN	27.5	20.3	30.5	32.9
MAX	45.5	47.2	42.3	48

	OLIPHANT, 1982-1983*			
	JUNE 82	SEPT 82	JUNE 83	SEPT 83
NO	102	226	77	192
MEAN-CM	30.43	27.75	32.09	31.22
ST DEV	6.13	6.14	5.14	7.29
MIN	21	17	23	17
MAX	41	43	43	43

*Source MNR (1984), Tables D26,28,30,32; in calculating statistics, 3.8 cm mesh catches were corrected (X2) to standardize effort

TABLE 3-7

DISTRIBUTION AND BIOLOGICAL CHARACTERISTICS OF ROUND WHITEFISH AT BRUCE GS "B" IN LATE FALL (OCTOBER-DECEMBER), 1983 AND 1984

	Year:	1983			1984		
	Pull dates:	Oct	Nov	Dec	Oct	Nov	Dec
		25,27	15,17	13,14	24,25	22	11
	3 m Temp Range-Deg C:	5-8	5-7	3-5.5	11-13	7-9	2-7.5
Catch	3 m nets:	66	86	39	30	22	12
by depth	12 m nets	10	30	5	6	4	4
	Total	76	116	44	36	26	16
3 m Catch	Douglas Pt	6	15	13	7	2	5
by Transect	B Discharge	8	15	8	3	6	4
	B Intake	15	16	7	10	1	0
	Holmes Bay	21	20	4	10	11	2
	Gunn Pt	16	20	7	0	2	1
No. Examined		76	39	44	35	17	15
Mean Fork Length - cm		37.8	39.4	39.3	39.2	38.8	41.5
Mean Weight - g		673	717	670	709	682	711
Sex Ratio as %							
Male		46	51	47	51	18	13
Female		49	46	37	46	82	87
Immature or unknown		5	8	16	3		
% of Females post-spawn		0	0	94	not determined		
Female Condition Factor:							
	Mean				1.102	1.128	0.970
	St. Dev.				0.100	0.179	0.074

Walleye were rare in the index netting program at Oliphant (MNR 1984, 1986), but were caught in small numbers in fall at Grand Bend on the south-east shore of Lake Huron. These fish were probably also adults, since almost all were taken in large meshes. Nearshore abundance at these sites was probably underestimated relative to our catches, since the minimum depth fished was 15 m.

3.5 Acoustic Observations of Fish in the Vicinity of the Submerged Intake

An acoustic survey was conducted on a grid centered on the submerged intake twice by day and once by night in each of June and September. The distribution of schools of pelagic fish and of aggregations of demersal fish is shown diagrammatically in Figure 3-8. Large schools (>10 m apparent width, based on echogram dimensions) were rare, being observed only during the first June day sample at the 14-15 m depth contours. Smaller schools of pelagic fish were observed infrequently through the remaining samples. All schools were within 3 m of the bottom. Midwater echoes occurred in the June night sample, but were rare and widely scattered. Demersal fish occurred singly or in small aggregations throughout both day and night samples.

Horizontal trends in the distribution of pelagic or demersal fish echoes were generally not apparent, although in the September 6 day sample the majority of fish were seen at or near the depth of the intake. There was no qualitative evidence of either attraction to or avoidance of the intake structure and depression, unlike 1983, when fish appeared to be clustered around the intake depression in some samples (OHRD Report No 86-166-K).

As an aid to determining fish species composition of observed echoes, gill nets were set on bottom in conjunction with the June 26 and September 6 and 11 day samples. On June 26, seven yellow perch and two longnose sucker were caught (Appendix 6), and these species probably contributed the bulk of demersal fish echoes. June acoustic sampling occurred midway between the June 5-6 and July 17-19 routine gill net surveys. Catches in the deep (12-15 m) sets were dominated by alewife and suckers on June 5-6, and by suckers and yellow perch on July 17-19. Near-bottom temperatures during the June acoustic survey were 8-13^{o}C (Appendix 6), similar to temperatures recorded at the routine survey nets on June 5-6. This suggests that alewife should have been present in appreciable numbers during the June acoustic survey, even though none were caught in the nets. In addition, the two large schools observed on the echograms resembled those typical of alewife.

Catches made in conjunction with September acoustic surveys were dominated by alewife and yellow perch, suggesting that these species contributed the bulk of observed echoes. No comparisons were made with the routine gill net survey catches in September due to the incomplete catch records.

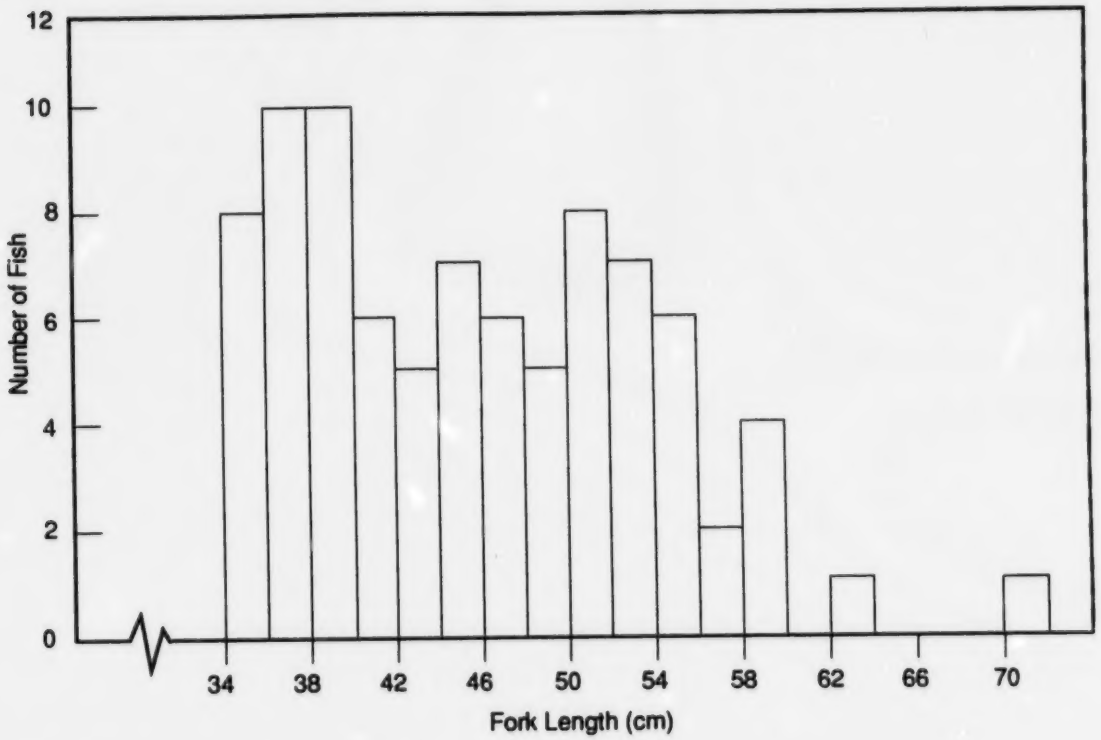


FIGURE 3-7

LENGTH DISTRIBUTION OF WALLEYE CAUGHT AT BRUCE GS "B", 1984

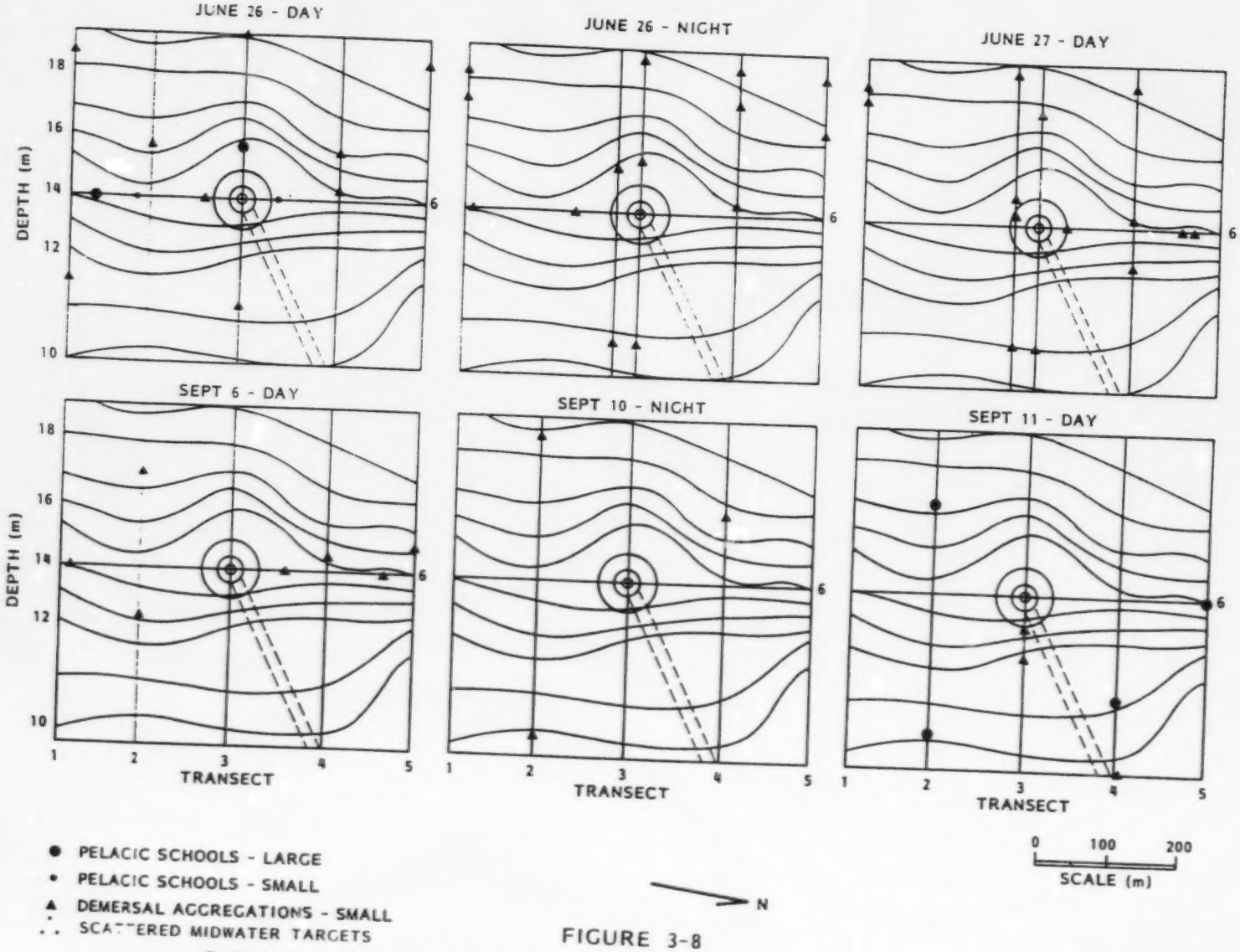


FIGURE 3-8

DISTRIBUTION OF ACOUSTICALLY OBSERVED FISH AGGREGATIONS
IN THE VICINITY OF BRUCE GS "B" INTAKE, 1984

90-212
169289 RD

A common feature of night samples obtained in spring and early summer in 1983 and earlier has been the presence of a midwater layer of echoes, representing the upward dispersal of fish which school near bottom by day. The absence of such a layer in June 1984 samples may have resulted from nocturnal movement of alewife out of the acoustically sampled area, probably closer to the surface and/or further inshore. Such movement was apparent in late spring on the north shore of Lake Ontario, where decreased nocturnal echo abundance was associated with increased alewife catches in inshore surface set gill nets (OHRD Report No 80-197-K).

4.0 SUMMARY

1. Seasonal changes in nearshore water temperature structure were generally similar to those seen in previous years. Major temperature fluctuations resulting from mass water movements such as upwellings were similar in magnitude, but more frequent than observed in 1983. The influence of the Bruce GS "B" thermal discharge was first seen in the July 18 temperature profile series.

2. Mean current speed (15 cm/s), dominance of (to the) northeast currents and current persistence were all greater in 1984 than 1983. The mean current speed was considerably higher than the long term average (11 cm/s) and outside the range observed in previous years. The current and temperature data together suggest that 1984 was an unusually severe year in terms of natural physical disturbance of nearshore habitat.

3. Drogue studies indicated that considerable offshore deflection of northeast currents was produced by the Bruce GS "B" groins and discharge jet with only one unit in operation. An aerial survey conducted immediately after a storm event which produced strong northeast alongshore currents was too early to show the influence of the discharge jet, but did reveal that erosion of material south of Bruce GS "A" was occurring primarily from the shorelines of Inverhuron Bay and Gunn Point and was slight along the Bruce GS "B" shoreline.

4. A detailed survey of substrates in the vicinity of the discharge was carried out before and after extension of the discharge groins. The substrates were dominated by exposed bedrock and boulder, as was found over the entire study area in preoperational years. Fine substrates (sand and silt) were a minor component both before and after groin extension, and actually decreased in importance in the second survey, probably as a result of wave action.

5. The catch of fish in monthly gill netting during the standard May-November period was generally similar in composition to that obtained in previous years. A relatively low total catch reflected a decrease in the catch of alewife. At the same time, increases over previous years in the relative importance of gizzard shad, rainbow smelt and burbot were apparent. White sucker replaced round whitefish as the most common species in the relatively sparse early winter (December) catch; this reflected a general decrease in round whitefish catches from 1983 to 1984.

6. Seasonal variation in catch-per-unit effort of major fish species generally reflected trends seen in previous years. An anomaly was observed in summer, as normal seasonal onshore-offshore movements were temporarily reversed for some species. Most notably, alewife left the inshore area in July and returned in August, while yellow perch were abundant in July, but became scarce in August. This was attributed early warming in July, followed by upwelling of cold water in August.

7. Most fish species were distributed fairly evenly among the netting transects. Walleye, however, were concentrated on the northernmost transects, where nets were exposed to maximum temperatures up to 4°C above inshore ambient. BNPD discharges north of the Bruce GS "B" site probably contributed most of the temperature elevation at the nets in 1984.

8. Round whitefish and walleye occurred at the site as adults only, with fork lengths ranging from 30 to 45 cm and 34 to 70 cm. The size distribution of these species was generally similar to that observed at the site in previous years. However, it differed from that observed by MNR at Oliphant 50 km north of BNPD in 15-55 m depths, where substantial numbers of juveniles 20 cm or less in length were taken.

9. Inshore abundance of both round whitefish and walleye peaked in fall. Some round whitefish spawning apparently occurred in or near the study area between the November and December sampling periods, which was consistent with previous years' results. Walleye were not caught during their spring reproductive period.

10. Acoustic surveys on a grid of transects centered on the intake did not show qualitatively consistent spatial trends in the distribution of fishes. There was no evidence to suggest either attraction to or avoidance of the intake structure or depression. The principal fish species observed acoustically appeared to be alewife and yellow perch.

5.0 ACKNOWLEDGEMENTS

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APPENDIX 1

HOURLY CURRENT DIRECTION (TO) AND SPEED (cm/s) AT CM-05
OFF BHMP ON SELECTED DATES IN 1984

MONTH:	MAY										JUNE									
DATE:	14		15		16		17		23		24		4		5		6			
HOUR																				
1	WSW	21	W	19	NE	10	NE	5	NNE	7	N	9	NE	10	NE	12	NNE	12		
2	WNW	18	W	18	NE	10	NE	6	N	9	NNE	9	NE	12	NNE	12	NNE	13		
3	W	19	W	19	NE	10	E	5	N	9	NNE	9	NE	13	NNE	11	NE	16		
4	W	19	WSW	22	NE	8	E	4	NNE	10	NNE	8	NE	12	NNE	11	NE	18		
5	WNW	20	W	19	NE	9	E	4	NNE	8	NNE	9	NE	14	NNE	12	NE	18		
6	SSE	18	W	18	NE	10	ESE	3	NNE	9	NNE	9	NE	12	NE	10	NE	16		
7	SSE	17	W	18	NNE	11	E	0	NNE	9	NNE	12	NE	13	NE	11	NE	16		
8	S	17	WSW	19	ENE	7	ESE	0	NNE	8	NNE	13	NE	16	NE	12	NE	17		
9	S	20	E	9	ENE	8	E	0	NNE	10	N	13	NE	15	NE	14	NE	16		
10	S	21	E	9	WNW	8	E	0	NNE	10	NNE	12	NE	15	NE	17	NE	13		
11	SSE	20	E	8	NNW	12	E	0	NNE	7	N	13	NE	17	NNE	16	NE	14		
12	W	20	E	10	NW	12	ESE	3	N	6	N	11	NE	14	NNE	15	NE	12		
13	NNW	22	W	12	SW	11	ESE	0	N	8	N	10	NE	13	NNE	17	NE	14		
14	NW	20	WSW	14	W	10	SE	4	N	8	N	15	NE	11	NE	17	NE	14		
15	NE	19	WSW	14	WSW	10	SSE	5	NNE	9	N	15	NE	11	NNE	18	NE	17		
16	NE	18	WSW	12	SW	9	SSE	4	NNE	8	N	16	NE	11	NNE	19	NNE	19		
17	ENE	17	WSW	12	SW	9	SSE	3	NNE	10	N	22	NE	18	NNE	18	NNE	19		
18	E	23	W	11	SSW	9	SE	3	NNE	9	N	21	NE	18	NNE	17	NE	20		
19	SSW	23	WNW	10	SW	8	S	0	N	9	N	23	NNE	18	NNE	16	NE	21		
20	SSW	24	WNW	8	SW	6	SSE	0	N	9	N	18	NE	17	NNE	14	NNE	20		
21	SSW	24	NNW	10	SSW	5	SE	0	NNE	8	NNE	24	NE	16	NNE	16	NE	20		
22	WSW	20	ENE	9	ENE	6	E	0	NNE	9	NNE	22	NE	13	NNE	15	NNE	20		
23	SW	21	ENE	8	WNW	7	ENE	5	NNE	10	N	19	NE	13	NE	14	NNE	20		
24	W	20	NE	10	NNE	7	ENE	4	NNE	10	N	21	NE	11	NE	14	NNE	24		

MONTH:	JULY								AUGUST				SEPTEMBER					
DATE:	16		17		18		19		20		21		5		6		7	
HOUR																		
1	NE	26	NE	20	NE	29	ENE	13	NW	4	NNW	5	W	11	NNE	9	N	8
2	NE	27	NNE	20	NE	30	N	12	NW	4	WSW	9	S	13	NE	11	NE	12
3	NE	28	NNE	21	NE	28	N	11	NNW	5	WNW	7	S	14	NE	12	SE	10
4	NNE	27	NNE	20	NE	27	N	11	N	5	WNW	8	S	13	NE	11	SSW	13
5	NNE	23	NE	20	NNE	28	ENE	11	N	8	SSE	8	SSW	13	NE	10	SW	10
6	NNE	25	NE	20	NNE	26	NE	11	NNE	5	ESE	10	SW	12	ENE	12	SSE	12
7	NNE	22	NE	23	NNE	25	NE	13	ENE	5	SE	10	NNW	12	NE	13	SE	11
8	NNE	25	NE	23	NE	26	ENE	14	ENE	5	SE	10	NNE	12	NE	13	ESE	12
9	NNE	27	NE	30	NE	24	ENE	16	NE	4	SSE	10	NNE	13	ENE	11	ENE	13
10	NNE	27	NE	28	NE	20	ENE	17	ENE	6	WSW	10	NE	13	NE	11	ENE	15
11	NNE	28	NE	32	NE	16	ENE	17	NNW	6	W	12	NNE	13	SW	9	NE	16
12	NE	31	NE	28	NE	13	NE	16	NW	6	WNW	13	ENE	12	SW	11	NNE	17
13	NE	30	NE	30	NNE	13	ENE	16	NW	6	WNW	10	ENE	10	NW	11	NNE	21
14	NNE	27	NE	29	NNE	16	NE	15	NW	4	NW	8	ENE	11	WNW	15	NNE	19
15	NNE	27	NE	30	NNE	16	NE	16	SE	11	NNW	8	ENE	12	NW	11	NE	19
16	NNE	26	NE	28	NNE	18	NE	19	SSE	10	N	9	ENE	11	NNE	11	NE	17
17	NE	28	NE	25	NE	12	NE	18	SSW	8	NNE	10	ENE	10	NNE	16	NE	16
18	NE	25	NE	23	NNE	12	NE	19	SW	9	NNE	10	S	13	NE	15	NNE	16
19	NE	26	NE	23	NNE	11	NE	21	W	8	NNE	10	SW	14	NNE	14	NNE	13
20	NNE	27	NE	28	N	13	NE	22	WNW	8	NE	10	S	17	NNE	12	NNE	13
21	NNE	26	NE	32	N	11	NE	23	SW	7	E	12	SSW	15	NE	15	NE	14
22	NNE	25	NE	32	NNE	12	NNE	24	SSW	6	ENE	10	ESE	11	NE	14	NE	16
23	NNE	23	NE	29	NNE	13	NE	24	SW	6	NNE	10	NE	11	NE	11	NE	15
24	NNE	21	NE	30	W	13	NNE	23	W	6	NNE	12	NNE	10	ENE	12	NE	15

APPENDIX 1 continued

MONTH:	SEPTEMBER								NOVEMBER				DECEMBER	
DATE:	18		19		24		25		21		22		10	
HOUR														
1	S	10	NE	16	NE	10	NE	26	SE	16	NNE	9	NE	11
2	S	12	NE	13	NNE	8	NE	25	NE	16	NE	9	NE	10
3	S	12	NE	13	NE	8	NE	20	ENE	16	NE	9	NE	10
4	SSE	12	NE	13	NE	7	NE	19	NNW	17	NNE	9	NE	10
5	SSE	12	NE	14	NNE	4	NNE	18	NE	16	NNE	12	ENE	8
6	SSE	12	NNE	13	NE	8	NNE	19	NE	15	NNE	13	NE	9
7	SSE	11	NNE	11	NE	8	NNE	23	NE	16	NNE	11	NE	8
8	SE	12	NNE	12	NE	7	NNE	22	ENE	15	NNE	11	NE	7
9	ESE	12	NNE	13	NNE	6	NNE	23	ENE	15	NNE	12	NE	6
10	ESE	12	NNE	13	NNE	7	NNE	21	ENE	16	NE	13	NE	4
11	ENE	13	NNE	15	NNE	7	NNE	22	NE	16	NE	13	ENE	5
12	NE	12	NNE	14	NNE	8	NNE	23	NE	15	NNE	15	ENE	5
13	NE	13	NE	14	N	7	NNE	26	NE	10	NNE	17		
14	NE	15	NNE	13	NNE	8	NNE	25	NE	10	NNE	18		
15	NE	16	NNE	12	NNE	9	NNE	26	NE	9	NNE	19		
16	NE	17	NE	12	NNE	12	NNE	28	NE	9	NE	20		
17	NE	16	NNE	11	NE	14	NNE	23	NE	9	NNE	22		
18	NNE	17	NNE	11	NE	15	NNE	25	NE	10	NNE	25		
19	NE	19	NE	11	NE	17	NNE	21	NNE	9	NNE	26		
20	NE	20	NE	12	NNE	15	NNE	21	NNE	10	NE	27		
21	NE	19	NNE	13	NE	16	NNW	20	NNE	9	NNE	27		
22	NE	19	NNE	17	NNE	23	NNW	27	NNE	9	NNE	29		
23	NE	17	NNE	21	NNE	24	NNW	26	NNE	10	NNE	27		
24	NE	18	NNE	20	NNE	25	NW	27	NNE	8	NNE	26		

APPENDIX 2
SUBSTRATE COMPOSITION IN THE VICINITY OF THE BRUCE DS "B" DISCHARGE IN 1984
As JUNE 5-7, BEFORE GROIN EXTENSION

DEPTH CONTOUR	SEGMENT	NORTH FROM THE DISCHARGE GROINS PERCENT COMPOSITION OF SUBSTRATES						SOUTH FROM THE DISCHARGE GROINS PERCENT COMPOSITION OF SUBSTRATES					
		Exposed	Overlying substrates				Total	Exposed	Overlying substrates				Total
		Bedrock	Boulder	Cobble	Gravel	Sand	%	Bedrock	Boulder	Cobble	Gravel	Sand	%
1 M	0 to 50m	0	0	10	90	0	100	90	0	9	1	0	100
	50 to 100m	0	0	15	80	5	100	80	0	5	15	0	100
	100 to 150m	0	0	30	70	0	100	80	5	0	15	0	100
	150 to 200m	50	5	45	0	0	100	60	5	5	30	0	100
	200 to 250m	0	35	60	5	0	100	85	10	1	4	0	100
	250 to 300m	50	30	20	0	0	100	5	0	90	5	0	100
	300 to 350m	85	10	5	0	0	100	99	1	9	0	0	100
	350 to 400m	50	25	25	0	0	100	85	0	10	5	0	100
	400 to 450m	95	5	0	0	0	100	90	0	5	5	0	100
	450 to 500m	75	10	10	2	2	99	90	0	5	5	0	100
	500 to 550m	97	1	2	0	0	100	95	2	2	1	0	100
	550 to 600m	97	1	2	0	0	100	90	5	5	0	0	100
	600 to 650m	100	0	0	0	0	100	90	5	5	0	0	100
	650 to 700m	100	0	0	0	0	100	90	5	2	3	0	100
	700 to 750m	100	0	0	0	0	100	90	3	2	5	0	100
	750 to 800m	100	0	0	0	0	100	90	5	5	0	0	100
	800 to 850m	100	0	0	0	0	100	90	3	2	5	0	100
	850 to 900m	100	0	0	0	0	100	85	3	10	2	0	100
	900 to 950m	100	0	0	0	0	100	85	3	10	2	0	100
	950 to 1000m	100	0	0	0	0	100	95	3	1	1	0	100
3 M	0 to 50m	0	35	50	15	0	100	0	0	10	90	0	100
	50 to 100m	0	35	50	15	0	100	10	5	65	20	0	100
	100 to 150m	0	60	30	10	0	100	100	0	0	0	0	100
	150 to 200m	0	20	75	5	0	100	100	0	0	0	0	100
	200 to 250m	70	10	20	0	0	100	95	5	0	0	0	100
	250 to 300m	70	10	20	0	0	100	80	0	20	0	0	100
	300 to 350m	70	10	20	0	0	100	100	0	0	0	0	100
	350 to 400m	20	5	15	0	0	100	100	0	0	0	0	100
	400 to 450m	80	5	15	0	0	100	5	5	60	25	5	100
	450 to 500m	98	2	0	0	0	100	42	6	50	0	0	100
	500 to 550m	100	0	0	0	0	100	60	15	15	5	5	100
	550 to 600m	100	0	0	0	0	100	60	15	15	5	5	100
	600 to 650m	40	0	0	60	0	100	60	20	15	5	0	100
	650 to 700m	40	0	0	60	0	100	95	0	5	0	0	100
	700 to 750m	40	0	0	60	0	100	95	0	5	0	0	100
	750 to 800m	40	0	0	60	0	100	95	0	5	0	0	100
	800 to 850m	55	10	0	35	0	100	95	3	1	1	0	100
	850 to 900m	55	10	0	35	0	100	95	3	1	1	0	100
	900 to 950m	55	10	0	35	0	100	95	3	1	1	0	100
	950 to 1000m	55	10	0	35	0	100	100	0	0	0	0	100
5 M	0 to 50m	60	0	35	5	0	100	0	10	75	15	0	100
	50 to 100m	0	50	40	10	0	100	5	90	3	2	0	100
	100 to 150m	10	50	40	0	0	100	0	85	5	10	0	100
	150 to 200m	45	40	15	0	0	100	0	85	10	5	0	100
	200 to 250m	10	90	0	0	0	100	0	85	10	5	0	100
	250 to 300m	99	1	0	0	0	100	10	75	14	1	0	100
	300 to 350m	99	1	0	0	0	100	88	2	10	0	0	100
	350 to 400m	0	100	0	0	0	100	0	50	50	0	0	100
	400 to 450m	0	100	0	0	0	100	5	60	35	0	0	100
	450 to 500m	38	25	25	10	2	100	5	60	35	0	0	100
	500 to 550m	95	5	0	0	0	100	40	40	10	5	5	100
	550 to 600m	95	5	0	0	0	100	40	40	10	5	5	100
	600 to 650m	95	5	0	0	0	100	0	60	25	10	5	100
	650 to 700m	95	5	0	0	0	100	0	30	60	5	5	100
	700 to 750m	0	50	50	0	0	100	0	30	60	5	5	100
	750 to 800m	0	100	0	0	0	100	0	30	60	5	5	100
	800 to 850m	85	10	5	0	0	100	0	30	60	5	5	100
	850 to 900m	0	100	0	0	0	100	0	30	60	5	5	100
	900 to 950m	75	25	0	0	0	100	80	10	10	0	0	100
	950 to 1000m	75	25	0	0	0	100	0	25	40	15	20	100
7 M	0 to 50m	50	45	5	0	0	100	0	50	30	15	5	100
	50 to 100m	95	5	0	0	0	100	0	50	35	10	5	100
	100 to 150m	50	40	5	5	0	100	0	10	50	30	10	100
	150 to 200m	60	35	5	0	0	100	0	10	50	30	10	100
	200 to 250m	75	20	5	0	0	100	0	60	30	5	5	100
	250 to 300m	85	15	0	0	0	100	0	60	35	5	0	100
	300 to 350m	75	20	5	0	0	100	0	60	35	5	0	100
	350 to 400m	60	35	5	0	0	100	10	60	20	5	5	100
	400 to 450m	70	25	5	0	0	100	100	0	0	0	0	100
	450 to 500m	80	20	0	0	0	100	0	50	35	10	5	100
	500 to 550m	75	25	0	0	0	100	10	10	75	5	0	100
	550 to 600m	100	0	0	0	0	100	65	10	25	0	0	100
	600 to 650m	100	0	0	0	0	100	70	15	15	0	0	100
	650 to 700m	100	0	0	0	0	100	90	10	0	0	0	100
	700 to 750m	25	5	50	20	0	100	35	10	25	10	0	100
	750 to 800m	30	20	50	0	0	100	35	10	25	10	0	100
	800 to 850m	40	10	50	0	0	100	35	10	25	10	0	100
	850 to 900m	40	10	50	0	0	100	35	10	25	10	0	100
	900 to 950m	40	10	50	0	0	100	0	50	25	25	0	100
	950 to 1000m	40	10	50	0	0	100	0	50	25	25	0	100

APPENDIX 2
B: AUGUST 29-29, AFTER GROIN EXTENSION

DEPTH CONTOUR	SEGMENT	NORTH FROM THE DISCHARGE GROINS PERCENT COMPOSITION OF SUBSTRATES Exposed Bedrock	Overlying substrates Boulder	Cobble	Gravel	Sand	Total %	SOUTH FROM THE DISCHARGE GROINS PERCENT COMPOSITION OF SUBSTRATES Exposed Bedrock	Overlying substrates Boulder	Cobble	Gravel	Sand	Total %
1 M	contour not done												
3 M	0 to 50m	0	40	60	0	0	100	85	15	0	0	0	100
	50 to 100m	0	10	90	0	0	100	95	0	5	0	0	100
	100 to 150m	60	5	35	0	0	100	90	5	5	0	0	100
	150 to 200m	60	10	30	0	0	100	80	15	5	0	0	100
	200 to 250m	60	10	30	0	0	100	70	5	20	5	0	100
	250 to 300m	70	10	20	0	0	100	5	10	70	15	0	100
	300 to 350m	70	10	20	0	0	100	70	5	15	10	0	100
	350 to 400m	60	30	10	0	0	100	90	5	5	0	0	100
	400 to 450m	0	20	80	0	0	100	0	30	70	0	0	100
	450 to 500m	0	20	80	0	0	100	0	20	80	0	0	100
	500 to 550m	95	0	5	0	0	100	70	30	50	0	0	100
	550 to 600m	95	0	5	0	0	100	20	40	40	0	0	100
	600 to 650m	100	0	0	0	0	100	0	40	60	0	0	100
	650 to 700m	95	0	5	0	0	100	90	5	5	0	0	100
	700 to 750m	100	0	0	0	0	100	100	0	0	0	0	100
	750 to 800m	95	0	5	0	0	100	100	0	0	0	0	100
	800 to 850m	0	10	90	0	0	100	90	5	5	0	0	100
	850 to 900m	10	40	50	0	0	100	80	10	10	0	0	100
	900 to 950m	40	10	50	0	0	100	90	5	5	0	0	100
	950 to 1000m	80	10	10	0	0	100	20	40	40	0	0	100
5 M	0 to 50m	70	25	5	0	0	100	0	80	10	10	0	100
	50 to 100m	0	50	25	10	15	100	10	70	10	10	0	100
	100 to 150m	0	60	30	5	5	100	95	0	2	2	0	99
	150 to 200m	0	60	30	5	5	100	100	0	0	0	0	100
	200 to 250m	0	60	30	10	0	100	90	0	5	5	0	100
	250 to 300m	0	60	30	10	0	100	85	10	5	0	0	100
	300 to 350m	90	0	10	10	0	100	70	15	15	0	0	100
	350 to 400m	90	10	0	0	0	100	70	15	15	0	0	100
	400 to 450m	70	30	0	0	0	100	5	45	50	0	0	100
	450 to 500m	85	15	0	0	0	100	50	0	45	5	0	100
	500 to 550m	0	100	0	0	0	100	0	80	15	5	0	100
	550 to 600m	5	90	5	0	0	100	0	80	15	5	0	100
	600 to 650m	90	10	0	0	0	100	50	40	10	0	0	100
	650 to 700m	100	0	0	0	0	100	0	90	10	0	0	100
	700 to 750m	95	5	0	0	0	100	10	70	15	5	0	100
	750 to 800m	95	5	0	0	0	100	70	30	0	0	0	100
	800 to 850m	85	15	0	0	0	100	100	0	0	0	0	100
	850 to 900m	60	40	0	0	0	100	95	0	5	0	0	100
	900 to 950m	25	75	0	0	0	100	95	5	0	0	0	100
	950 to 1000m	0	100	0	0	0	100	5	70	20	5	0	100
7 M	0 to 50m	75	15	10	0	0	100	0	80	15	5	0	100
	50 to 100m	75	15	10	0	0	100	0	80	15	5	0	100
	100 to 150m	75	15	10	0	0	100	0	25	60	15	0	100
	150 to 200m	75	15	10	0	0	100	0	55	30	15	0	100
	200 to 250m	75	15	10	0	0	100	0	80	10	10	0	100
	250 to 300m	75	15	10	0	0	100	70	5	5	20	0	100
	300 to 350m	75	15	10	0	0	100	40	45	5	10	0	100
	350 to 400m	75	15	10	0	0	100	20	60	15	5	0	100
	400 to 450m	75	15	10	0	0	100	0	75	25	0	0	100
	450 to 500m	75	15	10	0	0	100	20	20	50	10	0	100
	500 to 550m	20	80	0	0	0	100	50	30	15	5	0	100
	550 to 600m	95	5	0	0	0	100	95	0	5	0	0	100
	600 to 650m	80	20	0	0	0	100	90	5	5	0	0	100
	650 to 700m	70	20	10	0	0	100	70	15	10	5	0	100
	700 to 750m	50	30	10	10	0	100	90	10	0	0	0	100
	750 to 800m	100	0	0	0	0	100	0	95	5	0	0	100
	800 to 850m	95	5	0	0	0	100	10	60	30	0	0	100
	850 to 900m	80	10	10	0	0	100	30	50	20	0	0	100
	900 to 950m	90	5	5	0	0	100	95	5	0	0	0	100
	950 to 1000m	90	5	5	0	0	100	90	10	0	0	0	100

APPENDIX 3
FISH CATCH IN GILL NETS AT BRUCE GS "B", 1984
3.8 cm to 12.7 MESH NETS

DATE	SPECIES	TRANSECT	DOUGLAS POINT				BRUCE "B" DISCHARGE				BRUCE "B" INTAKE				HOLMES BAY				GUNN POINT				TOTAL		OVERALL
		DEPTH	3		12		3		12		3		12		3		12		3		12		3m	12m	TOTAL
		NET	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2			
May 16/17		8 DAYS SET	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	15	15	30
	ALEWIFE		15	8	9	5	15	12	11	3	32		28	6			21	2	2		11	1	84	97	181
	GIZZARD SHAD		1				3																4	0	4
	LAKE TROUT/SPLAKE																			1			1	0	1
	ROUND WHITEFISH		4	2	4	3	2		7	1	3			1		1		1	2	1		1	15	18	33
	LONGNOSE SUCKER		50	5	9	1	9	7	14	4	9	2	9	3	4		13	3	14	7	3	2	107	61	168
	WHITE SUCKER		7	1	1	2	1				7				4	2	4		1				23	7	30
	LAKE CHUB										1										1		1	1	2
	SPOTTAIL SHINER														2								2	0	2
	CHANNEL CATFISH		1				7		1		4								2				14	1	15
	BURBOT		3	2	13	8	3	1	5	4	1	2	14	3	4		13	1	11	6	6	5	33	72	105
	YELLOW PERCH		1		4	1	1		4					2				1			1		2	13	15
	TOTAL		82	18	40	20	41	20	42	12	57	4	51	15	14	3	51	8	32	15	22	9	286	270	556
June 5/6		8 DAYS SET	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	10	10	20
	ALEWIFE		20	103	30	70	26	142	3	57	4	55	29	49	31	140	23	78	19	137	10	73	677	422	1099
	GIZZARD SHAD										1												1	0	1
	COHO SALMON											1											1	0	1
	ROUND WHITEFISH				3	1	1	3	1	1			1		1		1	2	1			2	6	12	18
	LONGNOSE SUCKER		27	11	2	4	7	3	2	3	7	8	4	3	7	29	2	9	14	9	1	7	122	37	159
	WHITE SUCKER		7	2							1	2			4	4		2	4	2		1	26	3	29
	REDHORSE SUCKER			1			1					1											3	0	3
	LAKE CHUB								1										1				1	1	2
	CHANNEL CATFISH		2				6									1				3			12	0	12
	BURBOT		2	6	6	2	13	1	4	5	6	5	11	4	15	5	5	1	11	12	5	19	76	62	138
	SMALLMOUTH BASS																					1	0	1	1
	YELLOW PERCH		1	1	6	5								2		3	1	1			1	7	5	23	28
	TOTAL		59	124	47	82	54	149	11	66	19	72	45	58	58	182	32	93	50	163	17	110	939	561	1491
July 17/19		8 DAYS SET	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	10	10	20
	ALEWIFE		3	1	3	1		4	6	1		6			1	4				21		1	40	12	52
	GIZZARD SHAD															1	2						1	2	3
	LAKE TROUT/SPLAKE			1																			1	0	1
	LONGNOSE SUCKER		1	3	21		5	2	35	10	16	4	45	5	2		4	1		1	27		24	148	182
	WHITE SUCKER		17	13		17	5	16	5	11	3	7	1	29	8	13	4	6	6	27	19	18	115	110	225
	REDHORSE SUCKER										1												1	0	1
	LAKE CHUB									1													0	1	1
	CARP										1		1	1	1							1	2	3	5
	SPOTTAIL SHINER														1								1	0	1
	CHANNEL CATFISH		2				1	2						1	1				1				7	1	8
	BURBOT				2					1			1									2	0	6	6
	TROUT PERCH				1																		0	1	1
	SMALLMOUTH BASS				1																		0	1	1
	YELLOW PERCH			6	10	22	5	9	8	30	14	22	6	32	16	96	8	18	3	40	13	35	211	206	417
	WALLEYE		1				3	1		2		1			2				3		1		11	3	14
	FRESHWATER DRUM				1																		0	1	1
	TOTAL		24	24	43	40	19	34	54	56	35	40	54	68	32	114	18	25	13	89	60	77	424	495	919

APPENDII 3 continued

DATE	SPECIES	TRANSECT	DOUGLAS POINT				BRUCE "B" DISCHARGE				BRUCE "B" INTAKE				HOLMES BAY				GUNN POINT				TOTAL		OVERALL
		DEPTH	3		12		3		12		3		12		3		12		3		12		3a	12a	TOTAL
		SET	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2			
August 21		0 DAYS SET	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	5	5	10
	ALEWIFE		5		16		102		12		5		33		53		24		32		9		197	94	291
	GIZZARD SHAD										1												1	0	1
	COHO SALMON		1						1														1	1	2
	SMELT		16		4		3				10		5		1				3				33	9	42
	LONGNOSE SUCKER						9		4		19		3		8		6		24		6		60	19	79
	WHITE SUCKER						5				3		1		24								32	1	33
	REDHORSE SUCKER		1				2																3	0	3
	LAKE CHUB		1												1								2	0	2
	BURBOT				5				4				5				3		1		2		1	19	20
	YELLOW PERCH		2				12				3				6				5				28	0	28
	WALLEYE		2												1								3	0	3
	TOTAL		28		25		133		21		41		47		94		33		65		17		361	143	504
Sept 19/25		0 DAYS SET	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	10	10	20
	COHO SALMON						1																1		1
	RAINBOW TROUT						1																1		1
	ROUND WHITEFISH					3	1				4		5		2						1		7	9	16
	SPLAKE														1								1		1
	WALLEYE						2				4						1		5		1		11	2	13
	TOTAL	Note: Catch records only available for salmonidae and other game fish																							
Oct 24/25		0 DAYS SET	3	0	3	0	3	0	3	0	3	0	3	0	2	0	3	0	2	0	3	0	13	14	27
	ALEWIFE										1												1	0	1
	GIZZARD SHAD		75		27		94		31		112		56		173		17		145		26		539	157	696
	COHO SALMON		1				1																2	0	2
	CHINOOK SALMON		1						1						1								2	1	3
	LAKE WHITEFISH										1						1		2				3	1	4
	ROUND WHITEFISH		7		3		3		1		10		2		10								30	6	36
	SMELT		1				1								3		2				1		5	3	8
	LONGNOSE SUCKER		6		71		3		8		9		14		7		12		5		12		30	117	147
	WHITE SUCKER		9		40		13		11		4		8		3		6		2		13		21	78	109
	REDHORSE SUCKER		4				2				1		1						1				8	1	9
	LAKE CHUB												2								1		0	3	3
	CARP										1												1	0	1
	BROWN BULLHEAD												1										0	1	1
	CHANNEL CATFISH		5		3		5		14		9		2				3		4		2		23	24	47
	BURBOT		1		22		1		5		3		5				4		10		5		15	41	56
	WHITE BASS		2		1		4		1		5		4		5				5				21	6	27
	SMALLMOUTH BASS		1				2										1		1				4	1	5
	YELLOW PERCH		1		43				16		5		23				11		15		29		21	113	134
	WALLEYE		28		3		19		2		16		1		2		3		1				66	9	75
	FRESHWATER DRUM						1																1	0	1
	TOTAL		142		213		149		90		177		119		204		60		191		80		863	562	1425

APPENDII 3 continued

DATE	SPECIES	TRANSECT	DOUGLAS POINT				BRUCE "B" DISCHARGE				BRUCE "B" INTAKE				HOLMES BAY				GUNN POINT				TOTAL		OVERALL
		DEPTH	3		12		3		12		3		12		3		12		3		12		3a	12a	TOTAL
		SET	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2			
Nov 22		0 DAYS SET	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	5	5	10
	LONGNOSE GAR														1								1	0	1
	GIZZARD SHAD		1								1		1		1								3	1	4
	LAKE HERRING						1																1	0	1
	ROUND WHITEFISH		2		2		6		2		1				11				2				22	4	26
	LONGNOSE SUCKER		3		11		1		11		5		19		9		8		10		38		28	87	115
	WHITE SUCKER		5		14		2		4		2		6		21		4		11		9		41	37	78
	REDHORSE SUCKER						1								1								2	0	2
	LAKE CHUB		2		1				3						1		2		1		1		4	7	11
	CHANNEL CATFISH										1										1		1	1	2
	BURBOT		1		1				3				1		2		3						3	8	11
	WHITE BASS		1								1												2	0	2
	YELLOW PERCH				1																		0	1	1
	SAUGER						1								1								2	0	2
	WALLEYE		2				21		2		3								1				27	2	29
	FRESHWATER DRUM		2				3		1		3				4				2				14	1	15
	TOTAL		19		30		36		26		17		27		52		17		27		49		151	149	300
Dec 11		0 DAYS SET	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	5	5	10
	GIZZARD SHAD		1								4								1				6	0	6
	RAINBOW TROUT										1												1	0	1
	ROUND WHITEFISH		5		1		4		1						2		2		1				12	4	16
	SMELT										1												1	0	1
	LONGNOSE SUCKER		2		3		1		2				11		1		1				7		4	24	28
	WHITE SUCKER		7		9		4		10		3		9		12		5		2		10		28	43	71
	LAKE CHUB				1										3		3						3	4	7
	CARP																				1		0	1	1
	BURBOT				12		1		6		9		10		4		3		5				19	31	50
	PUMPKINSEED												1										0	1	1
	YELLOW PERCH		1		1				2		1		1				2		2		2		4	8	12
	WALLEYE		1				1				3												5	0	5
	FRESHWATER DRUM		2				2				6				1				1				12	0	12
	TOTAL		19		27		13		21		28		32		23		16		12		20		95	116	211

APPENDIX 4
FISH CATCH IN GILL NETS AT BRUCE GS "B", 1984
2.54 cm MESH NETS

DATE	SPECIES	TRANSECT	DOUGLAS POINT				BRUCE "B" DISCHARGE				BRUCE "B" INTAKE				HOLMES BAY				GUNN POINT				TOTAL		OVERALL TOTAL
		DEPTH	3		12		3		12		3		12		3		12		3		12				
DATE		SET	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	3	12	
May 16/17		8 DAYS SET	2	1	2	1	2	0	2	1	0	1	2	1	2	1	2	1	2	1	2	1	12	15	27
	ALEWIFE		1																				1	0	1
	SMELT			2	1							1								1			4	1	5
	LAKE CHUB													14									14	0	14
	SPOTTAIL SHINER											3	2	36	1	2		4				2	44	6	50
	BURBOT					1																	0	1	1
	TROUT PERCH																	1					1	0	1
	TOTAL		1	2	1	1	0	0	0	0	0	4	2	0	50	1	2	0	5	1	0	2	64	8	72
June 5/6		8 DAYS SET	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	9	10	19
	ALEWIFE		1	1				2			17				4			4	1	1	1	1	27	6	33
	SMELT			1		1				2					5		6					1	6	10	16
	LAKE CHUB							1															1	0	1
	SPOTTAIL SHINER		5			1	1	6			1							12		1		1	14	14	28
	TROUT PERCH				2		1									1		1					2	3	5
	YELLOW PERCH				1																		0	1	1
	TOTAL		6	2	3	2	2	9	0	2	18	0	0	0	9	1	6	17	1	2	1	3	50	34	84
July 17/19		8 DAYS SET	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	10	10	20
	LAKE TROUT/SPLAKE					1	1																1	1	2
	SMELT					1				3							1						0	5	5
	LONGNOSE SUCKER		1																				1	0	1
	LAKE CHUB		5	1				12				1						5		10	4		29	9	38
	SPOTTAIL SHINER		6	2	7	3	1	4	2	12	1	2		11	3	3	7	3			14	12	22	71	93
	BURBOT				1																		0	1	1
	TROUT PERCH																		3				3	0	3
	YELLOW PERCH					1				1				2		1					1	1	1	6	7
	TOTAL		12	3	8	6	2	16	2	16	1	3	0	13	3	4	8	8	3	10	19	13	57	93	150
Aug 21		8 DAYS SET	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	5	5	10
	ALEWIFE		1		1												1						1	2	3
	LAKE HERRING				1												1						0	2	2
	SMELT		7		55		10		87		17		45		43		28		8		73		85	288	373
	LAKE CHUB		1						2		7		7		4		6						12	15	27
	YELLOW PERCH		5				11		1		10				12				4				42	1	43
	TOTAL		14		57		21		90		34		52		59		36		12		73		140	308	448
Sept 19/25		8 DAYS SET	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	10	10	20

APPENDIX 4 Continued

DATE	SPECIES	TRANSECT	DOUGLAS POINT				BRUCE "B" DISCHARGE				BRUCE "B" INTAKE				HOLMES BAY				GUNN POINT				TOTAL		OVERALL
		DEPTH	3		12		3		12		3		12		3		12		3		12				TOTAL
DATE		SET	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	3	12	
Oct 24/		8 DAYS SET	3	0	3	0	3	0	3	0	3	0	3	0	2	0	3	0	2	0	2	0	13	14	27
	ALEWIFE						1														1		1	1	2
	SMELT		3					1		3		2		1		1		2			5		9	9	18
	LAKE CHUB				2		3									3							3	5	8
	EMERALD SHINER											1											0	1	1
	SPOTTAIL SHINER		4		1													4		1			8	2	10
	WHITE BASS		1																				1	0	1
	YELLOW PERCH							1										1					1	1	2
	TOTAL		8		3		4		2		3		3		1		4		7		7		23	19	42
Nov 22		8 DAYS SET	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	5	5	10
	ALEWIFE		1						1														1	1	2
	SMELT		1		2						1				1								3	2	5
	LAKE CHUB																		2				2	0	2
	SPOTTAIL SHINER														1								1	0	1
	TOTAL		2		2		0		1		1		0		2		0		2		0		7	3	10
Dec 11		8 DAYS SET	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	5	5	10
	SMELT		8		1		4		2		7												19	3	22
	EMERALD SHINER								1						2				2		2		4	3	7
	SPOTTAIL SHINER		1		1																		1	1	2
	TROUT PERCH						1																1	0	1
	YELLOW PERCH																3						0	3	3
	TOTAL		9		2		5		3		7		0		2		3		2		2		25	10	35

APPENDIX 5
WATER TEMPERATURES ASSOCIATED WITH GILL NETTING, BRUCE GS "B", 1984
A: COMPLETE PROBE DATA AT NET DEPTH

(^{o}C)

DATE	LOCATION	DOUGLAS PT		BR. B DISCH		BR. B INT.		HOLMES BAY		GUNN PT	
		2M ABOVE	BOTT.	2M ABOVE	BOTT.	2M ABOVE	BOTT.	2M ABOVE	BOTT.	2M ABOVE	BOTT.
MAY 14 (set) no temperatures taken due to rough seas											
MAY 16	3M - INSHORE END	NT	5.4	NT	5.5	NT	5.5	NT	6.8	NT	5.7
pull&	- OFFSHORE END	NT	4.8	NT	5.4	NT	5.3	NT	5.4	NT	5.0
reset	12M- INSHORE END	NT	4.6	NT	4.8	NT	4.8	NT	4.7	NT	4.9
	- OFFSHORE END	NT	4.5	NT	4.5	NT	4.4	NT	4.5	NT	4.2
MAY 17	3M - INSHORE END	NT	5.8	NT	5.1	NT	6.1	NT	6.9	NT	5.8
pull	- OFFSHORE END	NT	4.8	NT	4.8	NT	4.6	NT	4.7	NT	4.8
	12M- INSHORE END	NT	4.8	NT	4.8	NT	4.6	NT	4.7	NT	4.8
	- OFFSHORE END	NT	4.6	NT	4.2	NT	4.2	NT	4.6	NT	4.4
JUNE 4	3M - INSHORE END	9.0	9.0	9.0	9.0	10.2	10.2	11.2	9.8	9.8	9.5
set	- OFFSHORE END	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
	12M- INSHORE END	8.0	7.8	8.7	8.5	8.0	8.0	8.6	8.6	9.2	8.6
	- OFFSHORE END	7.7	7.5	7.7	7.5	7.8	7.5	8.3	8.1	8.2	8.2
JUNE 5	3M - INSHORE END	10.2	10.1	10.6	10.6	11.0	11.0	11.0	11.0	11.0	10.7
pull&	- OFFSHORE END	8.9	8.6	10.6	10.6	10.6	10.3	11.0	10.6	NS	NS
reset	12M- INSHORE END	8.5	8.2	9.8	9.6	10.0	9.7	10.6	10.2	10.5	10.2
	- OFFSHORE END	8.4	8.1	9.1	8.6	9.9	9.6	10.4	9.8	9.5	9.0
JUNE 6	3M - INSHORE END	9.8	9.5	11.6	11.4	11.5	11.5	12.1	12.0	12.0	12.0
pull	- OFFSHORE END	9.6	9.3	11.6	11.4	11.0	11.0	11.7	11.5	12.0	12.0
	12M- INSHORE END	9.5	9.2	9.4	9.4	10.0	10.0	11.7	11.5	10.7	10.7
	- OFFSHORE END	9.0	8.8	9.4	9.0	9.8	10.0	11.7	11.7	10.5	10.7
JULY 16	3M - INSHORE END	20.7	20.1	21.0	20.5	20.1	20.3	20.5	20.3	20.0	20.0
set	- OFFSHORE END	20.1	19.4	20.3	20.3	19.5	19.0	20.2	20.2	20.1	20.0
	12M- INSHORE END	20.1	19.4	20.3	20.3	19.5	19.0	20.2	20.2	20.2	20.0
	- OFFSHORE END	20.2	18.1	18.5	18.3	17.7	18.0	19.5	19.5	19.0	19.0
JULY 17	3M - INSHORE END	19.0	18.5	22.5	20.0	20.0	20.0	19.8	19.8	20.0	20.0
pull	- OFFSHORE END	18.3	18.0	19.7	19.5	19.5	19.5	19.5	19.8	20.0	20.0
	12M- INSHORE END	18.0	18.0	18.5	18.5	19.0	19.0	19.3	19.3	19.5	19.5
	- OFFSHORE END	17.5	17.5	18.5	17.5	18.9	18.9	19.0	19.0	19.0	19.0
JULY 18	3M - INSHORE END	18.5	18.5	19.4	19.2	20.5	19.5	19.5	19.0	19.5	19.5
reset	- OFFSHORE END	18.6	18.6	19.0	19.0	18.8	18.8	19.0	19.0	19.0	19.0
	12M- INSHORE END	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
	- OFFSHORE END	NT	NT	18.8	18.5	19.0	19.0	19.0	19.0	18.8	18.8
JULY 19	3M - INSHORE END	19.5	19.5	19.3	19.3	19.3	19.3	19.0	19.0	18.5	18.5
pull	- OFFSHORE END	18.5	18.0	18.0	18.0	18.5	18.5	18.8	18.0	19.0	19.0
	12M- INSHORE END	NT	NT	18.0	18.0	18.5	18.5	18.0	18.0	NT	NT
	- OFFSHORE END	17.6	17.6	18.0	18.0	18.5	18.3	18.0	18.0	17.5	17.5

NT Net set or pulled but temperature not taken due to rough seas

APPENDIX 5 A continued

DATE	LOCATION	DOUGLAS PT 2M ABOVE	DOUGLAS PT BOTT.	BR. B DISCH 2M ABOVE	BR. B DISCH BOTT.	BR. B INT. 2M ABOVE	BR. B INT. BOTT.	HOLMES BAY 2M ABOVE	HOLMES BAY BOTT.	GUNN PT 2M ABOVE	GUNN PT BOTT.
AUG 20	3M - INSHORE END	16.0	15.5	15.0	14.0	15.0	15.0	14.5	14.5	14.5	11.0
set	- OFFSHORE END	12.5	11.0	9.5	9.0	9.0	9.0	11.0	10.8	9.0	8.5
	12M- INSHORE END	11.0	10.5	9.0	8.0	9.0	9.0	11.0	10.8	9.0	8.5
	- OFFSHORE END	9.0	9.0	8.0	8.0	8.0	7.5	13.0	10.0	9.3	7.5
AUG 21	3M - INSHORE END	16.8	16.5	17.5	16.5	16.5	16.5	15.5	15.0	15.5	11.0
pull	- OFFSHORE END	16.8	16.5	17.5	16.5	16.0	16.0	15.0	13.8	15.0	13.5
	12M- INSHORE END	15.8	11.5	16.5	11.0	16.5	15.0	15.5	13.5	15.0	11.5
	- OFFSHORE END	10.0	9.5	8.0	8.0	15.5	10.0	15.5	14.0	15.5	12.0
SEPT 18-19 and 25-26 Probe data lost (thermograph data only)											
OCT 22	3M - INSHORE END	13.4	12.8	13.3	11.7	NT	NT	NT	NT	NT	NT
set	- OFFSHORE END	12.2	12.1	NT	NT	NT	NT	NT	NT	NT	NT
	12M- INSHORE END	11.1	11.1	NT	NT	NT	NT	NT	NT	NT	NT
	- OFFSHORE END	11.2	11.1	NT	NT	NT	NT	NT	NT	NT	NT
OCT 24,	3M - INSHORE END	NT	NT	NT	NT	NT	NT	11.5	11.5	11.2	11.2
25 pull	- OFFSHORE END	NT	NT	NT	NT	NT	NT	11.5	11.5	11.5	11.5
	12M- INSHORE END	NT	NT	NT	NT	NT	NT	NT	NT	11.2	11.2
	- OFFSHORE END	NT	NT	NT	NT	NT	NT	NT	NT	11.2	11.2
NOV 21	3M - INSHORE END	9.0	9.0	7.0	7.0	7.0	7.0	7.5	7.5	6.8	6.6
	- OFFSHORE END	8.3	8.0	7.5	7.0	6.6	6.6	6.8	6.8	6.8	6.8
	12M- INSHORE END	8.5	8.0	7.5	7.0	6.6	6.6	6.8	6.8	6.8	6.8
	- OFFSHORE END	6.5	6.3	6.5	6.5	6.6	6.6	6.6	6.6	6.5	6.5
NOV 22 (pull) no temperatures taken due to rough seas											
DEC 10	3M - INSHORE END	5.5	5.5	4.8	4.8	4.0	4.0	2.0	2.0	3.5	3.5
set	- OFFSHORE END	5.0	5.0	4.8	4.8	4.0	4.0	2.0	2.0	4.0	4.0
	12M- INSHORE END	4.9	4.9	6.0	6.0	4.5	4.5	3.5	3.5	4.0	4.0
	- OFFSHORE END	4.9	4.9	6.0	6.0	4.5	4.5	4.0	4.0	4.0	4.0
DEC 11	3M - INSHORE END	5.0	5.0	6.5	6.0	5.0	5.0	4.5	4.5	2.5	2.5
pull	- OFFSHORE END	5.0	5.0	7.5	7.5	5.0	5.0	3.5	3.5	2.5	2.5
	12M- INSHORE END	5.0	5.0	7.5	7.5	5.0	5.0	2.5	2.5	2.5	2.5
	- OFFSHORE END	5.0	5.0	5.0	5.0	4.5	4.5	3.5	3.5	3.5	3.5

NT Net set/pulled but temperature not taken due to rough seas

APPENDIX 5 B

B: SUMMARY OF TEMPERATURE RANGES DURING NET SETS

(^{o}C)

MONTH	DATES	DEPTH	PROBE TEMPERATURES AT NET						NEARBY THERMOGRAPHS			
			OVERALL		Doug. Pt to B Disch		B Int. to Gunn Pt.		B Disch		Gunn Pt (5m)	
			Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
MAY	14-17	3M	4.6	6.9	4.8	5.8	4.6	6.9	4.6	10.2	3.4	8.1
		12M	4.2	4.9	4.2	4.8	4.2	4.9	3.4	7.2		
JUNE	4-6	3M	8.6	12.1	8.6	11.6	9.5	12.1	9.3	12.7	7.6	12.7
		12M	7.5	11.7	7.5	9.8	7.5	11.7	6.6	9.9		
JULY	16-19	3M	18.0	22.5	18.0	22.5	18.0	20.5	18.5	21.5	19.1	20.9
		12M	17.5	20.3	17.5	20.3	17.5	19.5	17.1	19.6		
AUGUST	20-21	3M	9.0	17.5	9.0	17.5	9.0	16.5	9.0	18.1	7.1	17.5
		12M	8.0	16.5	8.0	15.8	8.0	16.5	5.6	18.0		
SEPT.	18-19,24-25	3M	nd	nd	nd	nd	nd	nd	17.1	18.8	16.3	17.6
		12M	nd	nd	nd	nd	nd	nd	16.6	17.1		
OCTOBER	22-25	3M	11.2	13.4	11.7	13.4	11.2	11.5	11.8	14.0	10.9	12.3
		12M	11.1	11.2	11.1	11.2	11.2	11.2	11.4	12.2		
NOVEMBER	21-22	3M	6.6	9.0	7.0	9.0	6.6	7.5	nd	nd	5.9	7.5
		12M	6.3	8.5	6.3	8.5	6.5	6.8	5.5	6.8		
DECEMBER	10-11	3M	2.0	7.5	4.8	7.5	2.0	5.0	nd	nd	nd	nd
		12M	2.5	7.5	4.9	7.5	2.5	5.0	nd	nd		

nd No data

APPENDIX 6
FISH CATCH AND TEMPERATURE PROFILES
OBTAINED IN CONJUNCTION WITH ACOUSTIC FISH CENSUS

A: FISH CATCH IN 3 HR GILL NET SETS:

DATE	June 26 (day)				Sept 6 (day)				Sept 11 (day)			
NET NO.	1	2	3	4	1	2	3	4	1	2	3	4
Fish catch:												
Alewife							10	5				
Rainbow smelt								1				
Longnose sucker	2											
White sucker									1			1
Redhorse sucker											1	
Yellow perch	5		2						7	3	16	

B: TEMPERATURE PROFILES TAKEN AT GRID CORNERS AND INTAKE DEPRESSION °C

	June 26(day)					Sept 6(day)					Sept 10(night)					Sept 11(day)				
	SE	SW	NE	NW	Dep.	SE	SW	NE	NW	Dep.	SE	SW	NE	NW	Dep.	SE	SW	NE	NW	Dep
Depth-m:																				
0	13	13	13	13	13	12	13	12	12	12	18	18	19	19	18	18	18	19	19	19
1	13	13	13	13	13	12	13	12	12	12	18	18	18	18	18	18	18	18	19	19
2	13	13	13	13	13	12	12	11	12	12	18	18	18	18	18	18	18	18	18	18
3	12	13	13	13	13	12	12	11	11	12	18	18	18	18	18	18	18	18	18	18
4	12	13	13	12	13	12	11	11	11	12	18	18	18	18	18	18	18	18	18	18
5	12	13	13	12	13	12	11	11	11	11	18	18	18	18	18	18	18	18	18	18
6	12	13	12	12	12	11	11	11	11	11	18	18	18	18	18	17	18	18	18	18
7	12	12	12	12	12	11	11	11	11	11	18	18	18	18	18	17	18	18	18	18
8	12	12	12	12	12	10	11	10	11	11	18	18	18	18	18	17	18	18	18	18
9	11	12	12	12	12	10	11	10	11	11	18	18	18	18	18	17	18	18	18	18
10		11	12	12	11		10	11	11	11		18		18	18	17	18		18	18
11		11	12	12	11		10		11	11		18		18	18		18		18	18
12		11		11	11		10		11	11		18		18	18		18		18	17
13		11		11	11		10		10	11		18		18	18		18		18	17
14		10		11	11		10		10	11		18		18	18		18		18	17
15		9		10	11		10		10	11		18		18	18		18		18	17
16		9		9	10		10		10	11		17		18	18		18		17	17
17		9		9	10		10		9	11				18	18		18		17	17
18		8		9	10		9		9	11				18	18		18		17	17
19		8		9	10		9		9	10				18	18		17		17	17
20				8	10					10				18	18				17	17

Note: Netting and temperature profiling during remaining acoustic surveys abandoned due to worsening weather.